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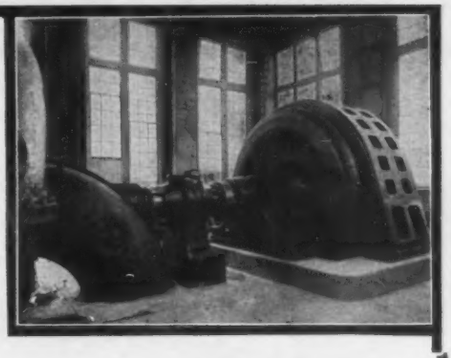

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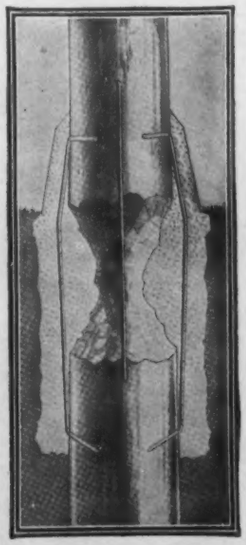

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VOLUME XXIX SAN FRANCISCO, SEPTEMBER 7, 1912 NUMBER 10

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THE SEATTLE AND PORTLAND HYDRAULIC WORK

Among the great engineering accomplishments of the Northwest, probably the greatest, in point of the benefits derived by a municipality, are the large regrading operations in Seattle and Portland.

The City of Seattle is built between the shores of Puget Sound on the west and Lake Washington on the east, the distance between the two being about two miles in the narrowest place. In the north central part of the city Lake Union, and still farther north Green Lake, two fresh bodies of water with a combined area of 1000 acres, are located. The topography of the townsite consists of a series of glacial moraines rising to an elevation of from 300 to 400 ft. and running in a general northerly and southerly direction. In its original state the business district was confined almost entirely to one or two streets along the waterfront of the eastern shore of Elliott Bay, and to a small level section adjoining the tide-flat area to the south of the business center.

Owing to this peculiar situation and the consequent spreading of the population over a large area (the land area of Seattle is about 58 square miles, and the water area 36 square miles, making a total of 94 square miles in the corporate limits), vast excavation projects have been necessary in order to create additional area for business purposes and to make possible the access by easy gradients from the outlying districts to the business center, thereby avoiding long detours around the prohibitive grades.

Hydraulicking at Guild's Lake, Portland.

The Local Improvement District Method of making improvements was adopted by the citizens of Seattle in 1892. Under the terms of this ordinance the various regrading projects are brought about in the following manner:

A petition for the work is circulated among the property owners in the district to be improved. When the signatures of 75 per cent of the interested owners have been secured favoring the work, the petition is presented to the city council for action. After being favorably passed upon by the council the city engineer is directed to lay out the improvement district, establish new grades on the streets affected, draw plans and make an estimate of the probable cost of the work. A board of eminent domain then determines the amount of damages or benefits accruing to the various ownerships. Property which is found to be damaged by the improvement is relieved of the payment of assessments, and the amount of the damages determined is included as part of the total cost of the work. Assessment roll maps are then prepared showing the assessments on each lot to cover the cost of the work. The assessment district often covers more area than the actual improvement district on account of benefits derived to adjacent property.

Bonds are issued by the city to pay the cost of the improvement. These bonds usually pay 6 per cent or 7 per cent interest, run for a term of from five to ten years, according to the size of the contract, and are secured by a first lien on the property in the district. The owners then have the privilege of paying their assessments into the city treasurer's office in cash, or in annual installments during the bond period.

The bond issue covers only the work done in city streets, private contracts being made between the contractor and property owners for the excavation on the lots.

In Seattle three districts have been improved by the hydraulic method of excavation, namely, the Jackson Street, et al., and the Dearborn Street, et al., districts in the southern portion of the city, and the Third Avenue, et al., commonly known as the Denny Hill district in the northern end of town. These districts are in addition to the large number of contracts in which the excavation has been done by steam shovel and cars.

In the Jackson Street contract, which was the first large contract to be let, a total of 5.8 miles of streets were improved and 56 square blocks of property were regraded, 29 of which required to be excavated and 27 of which were filled. Original grades of from 6 per cent to 18 per cent here were reduced to a maximum grade of 7 per cent and some as low as 1 per cent. Cuts ranged from 10 ft. to 94 ft., and fills as high as 45 ft., and a total of 3,347,000 cubic yards were excavated.

The unit prices for earthwork on this job were 10 cents a cubic yard for excavation and 15 cents per cubic yard for embankment, with an allowance of 15 per cent in the embankment for shrinkage. The total cost of this job was about $915,000.

Immediately after the completion of this contract, traffic which far years had taken a course a mile out of its way on account of the impassable grades on Jackson street, naturally came through this new outlet, with the result that delivery charges on building materials, fuel and supplies, were materially reduced to a vast area of outlying territory between the business center and Lake Washington. The contract was completed in December, 1910, and is already well built up with substantial business houses, whereas before the improvement it was nothing but a cheap residence and rooming house quarter.

Lewis & Wiley, Inc., the contractors for this work, installed a pumping plant on Elliott Bay for their water supply. The plant consisted of four 10 in. 5 stage Worthington centrifugal pumps direct connected in units of two pumps each to two 650 h.p Worthington motors. The capacity of these pumps was 12,000,000 gallons per 24 hours under 375 ft. head. The supply line to the work consisted of about 6100 ft. of 24 in. machine banded wood stave pipe. The working pressure at the giants was about 75 lb. per sq. in. An additional supply of 6,000,000 gallons per 24 hours was obtained from a steam pumping plant on Lake Washington, which the contractors leased from the city water department. This plant pumped directly into a reservoir on Beacon Hill having a capacity of 3,850,000 gallons, and the water was used from this reservoir under a gravity head of about 180 ft.

The material was transported to the dump, in some cases a mile from the point of excavation, in wood stave pipe lines from 20 in. to 22 in. in diameter. This pipe was reinforced on the bottom with wood blocks placed with the grain up to increase the life of the pipe.

In the portion of the Jackson Street contract which required filling, the streets were raised on pile trestles and the buildings were jacked up to the new grades and set on posts. In this way business went on without interruption while fills were being made beneath them in some cases 45 ft. deep.

The contract for the Dearborn Street district, which was awarded in August, 1909, called for the improvement of about 3.2 miles of streets, and 10 square blocks of private property. The principal object of this work was the opening of a new artery from the business center of town to the populous Rainier Valley and the southern end of Lake Washington. Grades of from 15 per cent to 18 per cent here were reduced to a maximum of 3 per cent, and a total of 2,169,542 cubic yards were excavated, of which about 125,000 cubic yards were removed by steam shovel.

The contract price on this contract was 20 cents a cubic yard for material excavated and placed in embankment.

From the surplus excavation in the combined Jackson and Dearborn Street jobs, 85 acres of tidelands in the south end of town were raised to an elevation above high tide and made available for building improvements. The approximate total cost of this work was $557,000.

The material excavated in the Dearborn and Jackson Street contracts consisted of a hard blue clay strata of glacial origin, with an overburden of about 12 ft. of soft yellow clay. This material in places was so compact and hard that it required continual blasting to loosen and break it up. From 250 to 400 lb. of powder were used daily in charges of from 2 to 3 lb. each.

In the Third Avenue, et al., district the excava-

tion was handled in the same manner as in the above mentioned work, with the exception that the material was transported in a box flume (instead of stave pipe) and was all wasted in Elliott Bay, the fill being kept at an elevation of 40 ft. below low tide.

A total of 2½ miles of streets and 21 square blocks were excavated here, with cuts ranging from 10 to 112 ft. and a total of 5,098,952 cubic yards of earth was moved at a unit price of 27 cents per cubic yard, making the total cost of this improvement $1,376,717.

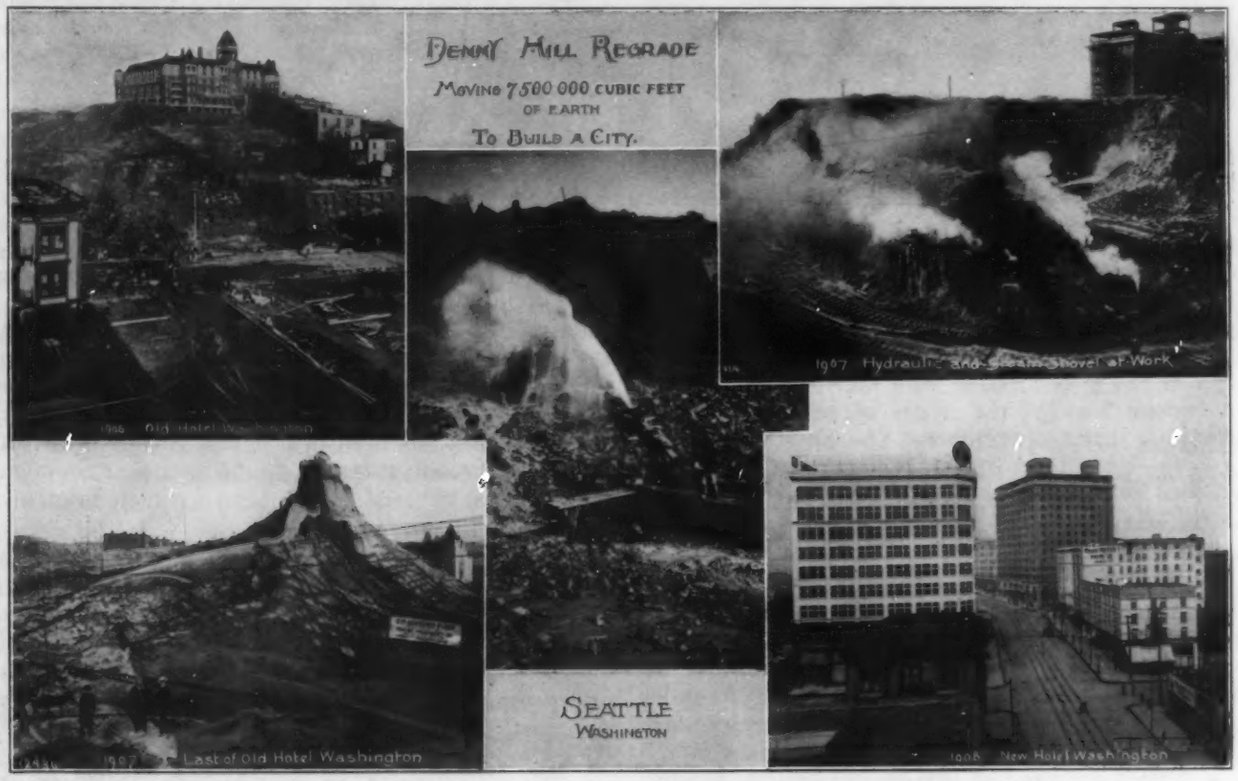
Summary of Hydraulic Work.

11½ miles of streets improved.
10,616,377 cubic yards excavated.
Total cost, $2,850,000.

R. H. Thomson, formerly city engineer of Seattle, states in his annual report to the council for the year ending November 30, 1910, that up to that time there had been moved in local improvement work a total of 14,936,251 cubic yards. Since that time the excavation in the three contracts mentioned has amounted to 1,850,000 yards, and together with the excavation by steam shovel and other sources the total to date would probably approximate 18,000,000 cubic yards.

At the date of this report the total cost of local improvement work, which does not include expenditures on account of water supply, was $31,331,109. The total at the present time will probably reach $35,000,000.

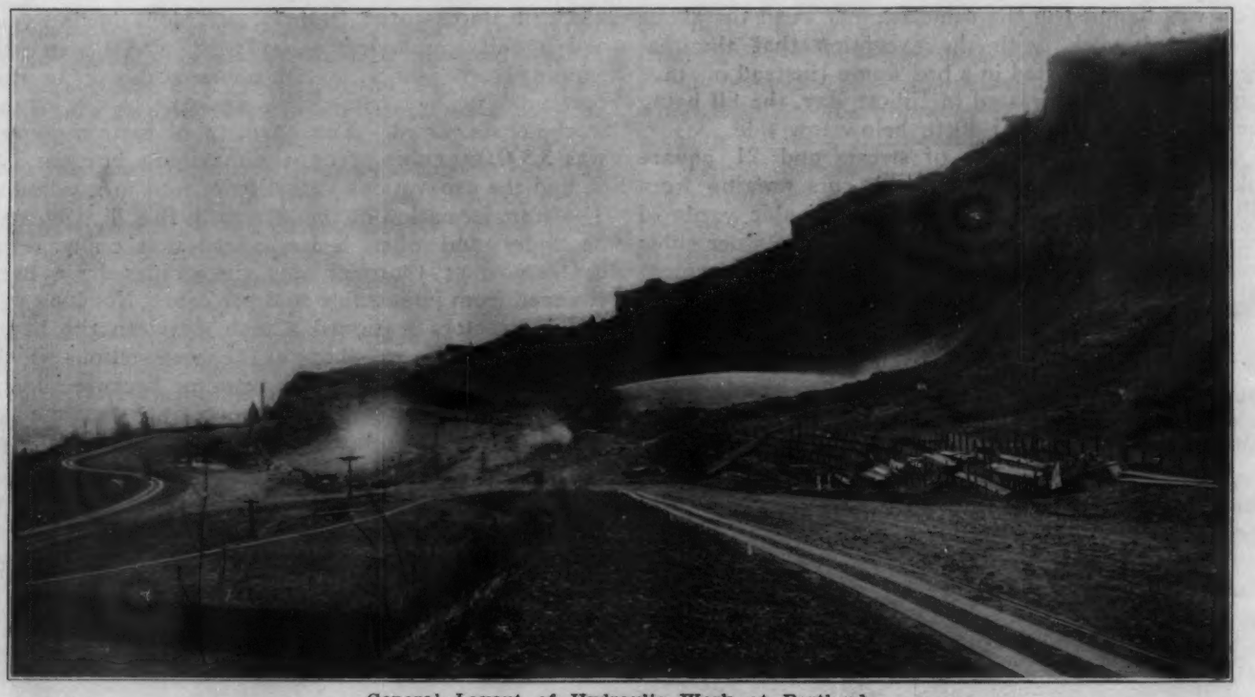
The following facts, compiled by the publicity department of the Seattle Chamber of Commerce, with regard to what is known as the Jackson Street project are of interest. This regrade involved an area of 128 acres practically in the heart of the city. The work, in its essential features, was done in one year and a half, employing an average of 200 men and running three shifts for 24 hours a day. On this particular job not one serious accident to any of the workmen occurred. The quantity of earth removed was 3,500,000 cubic yards; the maximum cut was 100 ft. and the excavations varied from zero to maximum. The transformation of the streets in this district may be understood when it is realized that on some of the important thoroughfares the grades have been changed from impassable to 3 per cent. Not long ago the contractors stationed a man, between the hours of 7 a. m. and 4 p. m., at one of the inter-sections which had not been available for teaming because of the steep grade. During those hours an average of 1 78-100 teams per minute passed that point. Since



Various Views of Work Accomplished at Seattle.

then the district has rapidly built up so that traffic is even greater. In the sluicing operations on this particular contract 24,000,000 gallons of water per day were utilized, one half of which was salt, pumped from the bay by an electric power pumping station, and one-half fresh, being the surplus taken from the city water system. The contractors realized 10 cents per yard for cutting away the hill and 15 cents per yard for filling in the tide-flats and raising the elevation of other low ground wherever they were able to dispose of the dirt.

Another one of the contracts, that for the removal of Denny Hill, which is more striking in the contrasts it affords between the old and the new than the Jackson Street, involved the removal of 6,000,000 yards with a maximum excavation of 130 ft. and an average of from 60 to 70 ft., 30,000,000 gallons of water were used for the sluicing work on this hill, while



General Layout of Hydraulic Work at Portland.

steam shovels and small dirt trains were also utilized. Some of the views will give an idea of the regrade of Third avenue. Similar work has been done on Fourth avenue. Third avenue, for instance, when it was widened in connection with the regrade, required the cutting back of the fronts of several buildings already on that thoroughfare. The New York building (a brick building) having a frontage of five stories on Third avenue, had a section taken out of the "L" and the main portion of the building fronting on Third avenue was moved back more than seven feet so as to obviate the necessity of reconstructing the front.

The Seattle Athletic Club building, at Fourth and Cherry streets (a brick and stone building of several stories) was kept at the same elevation above sea level, but had two stories built underneath in order to conform with the lowering of the street grades surrounding it.

Portland Work.

Actuated by their success in the sluicing operations in Seattle the Lewis-Wiley Hydraulic Company purchased, in 1909, several adjoining tracts of land in the City of Portland, with the idea of improving it by the same methods.

The total project covers an area of 142 acres, 65 acres of which lie on an abrupt hill on the west side of the city, rising to an elevation of 650 ft. above the city, surrounded by the best residence districts and commanding a wonderful panoramic view of the city and the Willamette and Columbia River valleys. One parcel of 40 acres lie in Guilds Lake, an overflow of the Willamette River, and the balance of 36 acres comprise a deep gulch running back from the lake and just west of the 65-acre tract. The general plan is to reduce the hill tract by the hydraulic method, and improve it as a first-class residence district of about 400 lots. The excavation is transported in a timber flume about 2500 ft. long, and is being used to fill up a part of the gulch and the 40-acre lake tract. The property is virtually being made to order. Every lot will be a view site, and the streets and boulevards will have a maximum grade of 8 per cent.

The work has been in progress since April, 1910, and at the present times is about 65 per cent complete, 1,989,000 cubic yards having been excavated out of a total of 3,210,000 cubic yards.

The contractors are using the same pumping plant on this work which they had in Seattle, with the addition of a two stage 16 in. Worthington pump direct connected to a 900 h.p. Westinghouse motor. This additional pump unit is necessary on account of the added head over that for which the Seattle plant was designed. The pumps are now delivering about 8,000,000 gallons per 24 hours against a head of 675 ft.

Work is carried on continuously 24 hours per day, and about 100,000 cubic yards per month are being moved. At this rate the project will be completed in about twelve months.

The total project will represent an outlay of about $1,350,000, including the cost of the property, excavation, and street improvements.

SALARIES OF TECHNICAL GRADUATES.

The following statistics have been compiled from recent returns from the graduates of the Massachusetts Institute of Technology, classes of 1907 and 1908. Although the returns for each class are not complete, the average annual salary of 106 members of the class of 1907 was $2028, the lowest being $600 and the highest $6000. The replies received from 139 members of the class of 1908, showed an average annual salary of $1796 per annum, the lowest being $520 and the highest $5200.

THE USE OF SMALL PUMPING PLANTS FOR IRRIGATION IN BRITISH COLUMBIA.

BY B. A. ETCHEVERRY.

While British Columbia is favored with a system of large rivers such as the Thompson, the Fraser, the Kettle Valley and lakes such as the Okanagan, these splendid large bodies of water are practically not available for gravity irrigation because of the topography of the irrigable land. The irrigable land exists usually in separate small valleys formed on both sides of smaller streams, or in small benches high above the rivers or lakes, generally with considerable slope towards these bodies of water. This position of the irrigable land combined with the flat grade of the rivers makes diversion by gravity flow directly from these sources an economical impossibility. These conditions have made it necessary to utilize the smaller streams or creeks, the flow of which is irregular, being abundant at the beginning of the irrigation season but in many cases decreasing to an insufficient volume before the close of the season. Most of the watersheds of these streams are favored with reservoir sites which can be utilized at a moderate cost to regulate the flow. Up to the present the natural stream flow, supplemented in some cases with storage water, has been the usual source of supply. Naturally the systems most easily constructed were installed first and the best available sources have been taken up. With the increasing demand for water to put new land under irrigation, less favorable sources of water supply must be utilized and the cost of development will become greater. There will still remain bodies of land for which no gravity water is available or only available at a very high cost, and which may be situated at a moderate elevation above the large rivers or lakes. For these conditions the development of a water supply by pumping may be the best solution. The information given below applies to small pumping plants, irrigating from about 10 to 100 acres.

Considerations Controlling the Selection of a Pumping Plant.

The proper selection of a pumping plant depends upon many factors which should be carefully considered by the intending purchasers. These factors are: (1) capacity of plant and period of operation, (2) the kind of pump, (3) the class of engine or driving power, (4) the first cost, (5) fuel cost, (6) cost of fixed charges and attendance. These factors are interdependent and should be considered together. Their relative importance will vary with local conditions and for that reason it is not possible to state definite rules which will apply in all cases. A study of the conditions affecting each factor is therefore necessary in each case.

Capacity of Plant and Period of Operation.

The required capacity of the plant will depend on the area irrigated, the duty of water or depth of water required on the land and the period of operation. For ordinary orchard soil in the arid part of British Columbia a total depth of 12 in. of water during the irrigation season will be sufficient for young orchards. For a full bearing orchard 18 in. should be ample, while for alfalfa and other forage crops 24 to 36 in. is plenty. Where the cost of pumping is high, such as for small plants and high lifts, it will usually not be feasible to grow at a profit anything but orchards. To reduce the cost of pumping, no excess water should be used, all losses should be prevented by careful irrigation and thorough cultivation, in which case a young orchard on fairly deep retentive soil may not require more than 6 to 9 in. of irrigation water and a full bearing orchard not more than 12 or 15 in. during the irrigation season. To put a depth of 2 ft. of water on one acre, it takes a flow of very nearly 1 cu. ft. per second for 24 hours; this is equivalent to 450 U. S. gallons per minute for 24 hours. This relation can be applied to any case to obtain the size of the pump. For example, if it is desired to irrigate a 40 acre orchard 1½ ft. deep, in an irrigation season of 120 days, this requires 60 acre ft. in 120 days, or ½ of an acre ft. per day. This will be obtained by a pump giving ¼ of a cu. ft. per second, or 110 U. S. gal. per minute, when the pump is operated continuously 24 hours a day every day during the irrigation season of four months. For a 10 acre orchard the required capacity based on the same conditions would be ¼ the above or 28 gallons per minute or 1-16 of a cu. ft. per second, or about 2¼ British Columbia miners' inches.

The above two examples are based on a pump operating continuously at the rates given above. While continuous operation decreases the required size of plant, it is usually preferable to select a plant of larger capacity and operate it only a part of the time. This is especially desirable for very small orchards in which case continuous operation gives a stream too small to irrigate with. The other disadvantages of continuous operation are:

1st. Continuous operation requires continuous irrigation and constant attention to operate the pumping plant. For very small tracts a regulating reservoir may be used, but it must be of considerable capacity to be of any service and it must be lined with concrete to prevent seepage losses of the water which when pumped is too valuable to lose. Usually it is preferable to purchase a larger plant and do without a reservoir.

2d. Continuous operation means that the water can not be applied to the different parts of the orchard within a short time, so that only a small part of the orchard or farm receives the water when most needed, and the remainder must be irrigated either too early or too late.

3d. Continuous operation gives a small stream which can not be applied economically.

4th. A small plant is less efficient and requires a proportionately larger fuel consumption than a larger plant to pump the same quantity of water.

On the other hand a very short period of operation requires a comparatively large pumping plant which will greatly increase the first cost of installation, the interest on the capital invested, the depreciation and fund necessary to provide for renewal.

Usually it is desirable to operate the pump not over ½ or 1-3 of the time during the irrigation season and often a shorter period is desirable. This requires a pumping plant two or three times or more the size required for continuous irrigation. The capacity of the pump must be sufficient in all cases to give a large enough stream to irrigate economically; even for the

smallest orchards a stream of at least 5 miners' inches or about 63 U. S. gallons per minute, is desirable.

For a full bearing orchard 18 in. of irrigation water applied in about three irrigations of 6 in. each at intervals of 30 to 40 days should be ample in most cases. As stated above, where the water has to be pumped to a high elevation the higher cost of the water demands great care in its use and 12 to 15 in. total depth of irrigation water would be sufficient.

The table below gives the required pump capacity for various sizes of orchards or farms and for different periods of operation. It is based on a depth of irrigation water of 6 in. each month, or 18 in. in 3 months, which is taken as the irrigation season. The period of operation is given in number of 24 hour days that the pumping plant is operated each month. These days need not be consecutive; for instance if the operation period is 10 days, instead of applying 6 in. of water in one irrigation lasting 10 days, the soil may be so porous and gravelly that it will not retain moisture, in which case it may be preferable to apply 3 in. at a time in two irrigations during the month, of 5 days each. The required pump capacity is given in U. S. gallons per minute of Imperial gallons because the pumps sold in British Columbia are mostly rated in U. S. gallons per minute.

Necessary Capacity of Pumps in U. S. Gallons Per Minute to Give a 6-Inch Depth of Water on the Land Each Month When Operated the Following Number of 24 Hour Days Per Month.

Area Acres.	30 days.	20 days.	15 days.	10 days.	5 days.	2½ days.	1 day.
5	19	28	38	56	113	225	563
10	37.5	56.25	75	112.5	225	450	1125
15	57	85	113	170	340	675	1690
20	75	113	150	225	450	900	2250
30	113	169	225	338	675	1350	3375
40	150	225	300	450	900	1800	4500
60	226	338	450	675	1350	2700	6750
80	300	450	600	900	1800	3600	9000
120	450	675	900	1350	2700	5400	13500

The capacity of pumps for smaller or greater depths of water applied per month can be easily computed by proportion from the values given. For different areas and different periods of operation the capicity may be obtained by interpolation.

Kind of Pump.

The kinds of pump commonly used to raise water for irigation are (1) centrifugal pumps, (2) power plunger pumps, (3) deep well pumps, (4) air lift pumps, (5) hydraulic rams.

Deep well pumps and air lift pumps are used for pumping underground water from deep wells. In British Columbia the underground water supply is unknown and need not be considered at present when the water supply is obtainable from the large streams and lakes adjacent to irrigable area. For pumping from these sources the centrifugal pumps and the power plunger pumps are the best adapted. Hydraulic rams are used for small quantities of water such as for domestic purposes or for irrigation of small pieces of land. They are economical in operation, but require special conditions such as a nearby stream with sufficient fall in a short distance. The choice between a centrifugal pump and a power plunger pump will depend on the capacity required and the height of lift.

Centrifugal Pump.

A centrifugal pump consists of a circular casing with the inlet or suction end connected to the center and the outlet or discharge end formed tangent to the perimeter. Inside the casing is the runner or impeller keyed on the shaft and revolving with it. It is formed of curved vanes closely fitting the casing and corresponds to the piston or plunger of a plunger pump. When in operation the impeller by revolving imparts a velocity to the water between the vanes and forces it away from the center of the casing towards the perimeter or rim of the casing through the outlet and up the discharge pipe. This produces a partial vacuum at the center of the impeller which induces a flow through the suction pipe into the casing. The number of revolutions of the runner or speed of the pump has an exact relation to the head or lift against which the pump is working and for every head there is a speed for which the pump works most efficiently. This speed can be obtained from the pump manufacturers. It is important that the pump be connected to an engine or motor which will give it the proper speed. Overspeeding is preferable to underspeeding but either reduce the pump efficiency.

Simple centrifugal pumps specially designed and driven at a sufficiently high rate of speed may be used for lifts considerably over 100 ft., but usually the stock pump obtainable from the manufacturers is not suitable for lifts over 75 ft. and for the smaller sizes the total lift should not exceed 50 ft. For higher lifts compound or multi-stage centrifugal pumps are used. These consist of two or more pumps connected in series, the discharge of the first pump or stage is delivered into the suction of the next pump and the operation is repeated according to the number of stages. Usually 75 ft. to 125 ft. is allowed to each stage.

Where the required capacity of the pump is over 100 or 150 gallons per minute and the total lift less than 75 ft., the centrifugal pump is no doubt the best adapted.

Centrifugal pumps are usually denoted by a number which represents the diameter of the discharge in inches. The efficient capacity of each size will vary to some extent with the speed of the pump which depends on the total lift pumped against. The pumps can, therefore, not be rated accurately. The capacities given in the accompanying table are worked out from the ratings given by a reliable pump manufacturer and are subject to considerable variations either above or below the values given.

No. of pump or of discharge in inches.	Capacity in U. S. gallons per minute.	Capacity in second feet or acre inches per hour.	Capacity in British Columbia miners' inches.	Number of acres irrigated, 6 in. deep each month for operation period, during the month, of							
				30 days.	20 days.	15 days.	10 days.	5 days.	2½ days.	1 day.	
2	100	.22	8	27	18	13	9	4½	2¼		9-10
2½	150	.33	12	40	27	20	13	6½	3¼	1	8-10
3	225	.50	18	60	40	30	20	10	5	2	
3½	300	.66	24	80	53	40	27	13	6½	2	2-3
4	400	.90	32	110	71	55	36	18	9	3	2-3
5	700	1.60	57	190	127	95	63	32	16	6	1-3
6	900	2.00	71	240	160	120	80	40	20	8	
7	1200	2.70	95	320	213	160	107	54	27	10	2-3
8	1600	3.50	125	430	287	215	143	72	36	14	1-3

To start a centrifugal pump the suction pipe and the pump must be filled with water or primed. This may be done by closing the discharge pipe with a check valve and connecting the suction end of a hand pump to the top of the casing. Where a steam engine is used a steam ejector may take the place of the hand

pump. For small pumps and low lifts a foot valve on the end of the suction pipe may be used and the pump primed by pouring water in the casing, or suction pipe. The disadvantage of a foot valve is that if the water is not clear a small stone or twig may lodge itself in the foot valve and prevent priming. This will necessitate that the suction pipe be uncoupled and the obstruction removed.

The pump must be placed as near as possible to the water level to keep the suction lift down. While theoretically the suction lift may be as great as 33 ft. at sea level and about 30 ft. at an elevation of 3000 ft., it is desirable not to exceed 20 ft. and less is preferable.

The plant efficiency can be increased by reducing the friction in the suction and discharge pipes. As few bends as possible should be used and these should be made by using long turn elbows. The suction and discharge pipes should be larger than the intake and outlet openings of the pumps and joined to the pump with an increaser. The diameter of the suction pipe and especially of the discharge pipe should be 1½ times the diameter of the intake and if the discharge pipe is long it may be economy to make its diameter even larger. Enlarging the lower end of the suction pipe will further decrease the friction. This may be done by a funnel-shaped section whose length is about 3 times the diameter of the suction pipe and whose large end is about 1½ times the diameter of the pipe. The larger opening at the entrance to the suction pipe will decrease the tendency to suck up sand or gravel. When the water carries weeds, gravel, or other material a strainer should be used and the total area of the strainer should be at least twice the area of the suction pipe. The discharge pipe should not carry the water any higher than necessary.

Choice Between Centrifugal Pump and Power Plunger Pump.

The choice between a power pump and a centrifugal pump will depend on the lift and capacity.

In irrigation work power pumps are best adapted to high heads above 75 ft. and to small or moderate volumes of water, usually under 200 gallons per minute. For these conditions the efficiency of a power pump is usually greater than that of a centrifugal pump. For greater volumes the plunger pumps are comparatively expensive and centrifugal pumps are usually preferable unless the lift is excessive. The centrifugal pump has the advantage that it is simple in construction with no parts to get out of order, and that it is cheaper than a power pump. The selection should be made only after careful consideration of the first cost of the pump and the annual cost of fuel, operation and maintenance. Where the lift is high the fuel cost will be considerable and it is good economy not to select the cheapest pump obtainable but one that is guaranteed for a high efficiency. On the other hand if the pump is only to be operated a very small portion of the season it would be poor economy to invest a large capital in a high grade pump to save in fuel cost.

Capacity of Engine.

The power necessary to lift water is indicated in horsepowers. A horsepower represents the energy required to lift 33,000 lb. 1 foot high in one minute; this is equivalent to 3960 gallons of water per minute raised 1 foot high. This relation enables one to find the horsepower required in any case by multiplying the discharge of the pump in gallons per minute by the total lift in feet and dividing by 3960. The result obtained represents the useful water horsepower necessary to lift the water. The horsepower delivered by the engine to the belt or gears when the pump is belted or geared to the engine, or to the pump itself when direct connected, is the brake horsepower and must be greater than the useful horsepower to allow for the loss of energy in the pump and transmission. The horsepower developed within the engine itself is the indicated horsepower and must be greater than the brake horsepower to allow for the energy loss in the engine itself. Gasoline engines and motors are rated on brake horsepower. Steam engines are rated on indicated horsepower.

The combined efficiency of a pumping plant represents the ratio of the useful water horsepower to the rated horsepower of the engine, and will vary considerably with the type of pump, method of connection of engine with pump and the care taken in operating both pump and engine at the proper speed. In ordinary field practice a good pumping plant, properly installed, should easily reach the efficiency given in the following table:

Efficiency of Centrifugal Pumping Plants.

No. of centrifugal pump.	Discharge in U. S Gallons per minute.	Water horsepower per foot of lift.	Efficiency.	Brake horsepower per foot of lift.
2	100	.025	30 per cent	.081
2½	150	.038	35	.11
3	225	.057	40	.14
3½	300	.08	45	.18
4	400	.10	45	.22
5	700	.17	50	.34
6	900	.23	50	.46
7	1200	.31	50	.62
8	1600	.41	55	.75

ELECTRIC TRAMWAY CONSTRUCTION AND EQUIPMENT IN COSTA RICA.

The Official Gazette of Costa Rica, of July 4, invites tenders for a concession for constructing and working for 50 years an electric tramway between Alajuela and Grecia, with a branch line to San Pedro de Poas, a total length of about 16¾ miles. The estimated cost of constructing the tramway is placed at 1,076,800 colons ($500,712). The estimated cost of a hydroelectric power plant on the Poas River for working the tramway is placed at 655,803 colons ($304,948). All material required for construction and equipment of the undertaking may be imported free of duty, and the Government guarantees interest from date of opening of tramway to public service for a period of 25 years at 6 per cent per annum on capital invested up to a total of 1,000,000 colons ($465,000).

Further particulars and plans may be obtained from the Direccion General de Obras Publicas, San Jose, at a cost of 25 colons ($11.63) per set. The Purdy Engineering Company, of San Jose, which made the preliminary surveys, would also probably be prepared to supply plans, but it is not known what its charge would be.

THE FACTOR OF SAFETY.

As Called for by the United States Tables of Steam Pressure on Steam Boilers.

REVISED BY J. B. WARNER.

[Concluded.]

Single Welt Lap Joints.

This style of joint is used on large wood pulp digesters, and other work where there are but few fittings and high pressures are necessary.

It is necessary to have well-proportioned joints, if the boilers are to run at as high pressures as are calculated in the table of pressures published by the U. S. Treasury Department

The factor for safety is low, being only 4 2/10 for new and perfectly proportioned joints.

The question is often asked, Why is it necessary to make the longitudinal seams so much stronger than the transverse or girth seams?

The reason is, that the strain on the longitudinal seams is twice that of the transverse seams.

In some types of boilers it is more than twice, for in the Return Tubular, or a boiler having tubes and stays from head to head, they relieve the transverse seams, while the longitudinal seams have the full load to carry.

On the transverse, or girth seams, the pressure would be; the area of the head being .7854 × (square of the diameter), the total pressure upon it would be:

$$.7854 \times (\text{diameter})^2 \times \text{pressure}.$$

This pressure acts endwise along the boiler, tending to pull it apart; and it is withstood by the plates of the boiler, and where these come together at the girth seams, the length of each girth seam is the same as the circumference of the boiler; that is, it is equal to

$$\frac{.7854 \times (\text{diameter})^2 \times \text{pressure}}{3.1416 \times \text{diameter}}.$$

Since 3.1416 is exactly 4 times .7854, we find, from the above calculation, that the strain on the girth seam per in. of its length, is:

$$\frac{\text{diameter} \times \text{pressure}}{4}$$

We thus see that the strain on the girth seam of a boiler is just half the strain on the longitudinal seam, so that if the former is half of the strength of the latter, the two are equally well adapted to the loads they have to carry when the boiler is in operation.

In a boiler with a longitudinal seam having a strength of 85 per cent of the solid plate, the girth seam will be as strong in proportion if only 42½ per cent of the strength of the solid plate, whereas, a well-proportioned single-riveted joint is 56 to 58 per cent.

On all water tube boilers the safety factor should be 5. On lap joints a pressure of over 165 lb. should not be allowed. Standard tubes should not be allowed over 175 lb. pressure. If more pressure is desired, heavier tubes should be put in. Blow-off pipes over blow-off pipes should be used in preference to a larger size.

Packing-Rings.

Packing-rings for pistons are turned to a diameter one-eighth inch larger than the cylinder for every foot in diameter of the cylinder. This is necessary in order that they may spring out and fill the cylinder, a piece being afterward cut out of the ring to make it the proper size. The ring is cut in an oblique direction in order to prevent the ends or joints from scoring the cylinder. The length of piece required to be cut out of the ring is equal to the difference between the external circumference of the ring and the circumference of the cylinder.

Example—A packing-ring for a piston is 60⅝ in. in external diameter before being cut. The diameter of the cylinder is 60 inches. How much should be cut out of the circumference of the ring to make it eactly fit the cylinder when sprung in?

$60.625 - 60 = .625$.

$.625 \times 3.1416 = 1.96$ in.; the amount to be cut out.

SUMMARY OF CONCLUSIONS ON OIL-MIXED PORTLAND CEMENT CONCRETE.

The following conclusions as to the effect of the oils used in cement and concrete may be drawn from the recent investigations of the U. S. Office of Public Roads.

(1) The tensile strength of 1:3 oil-mixed mortar is very little different from that of plain mortar, and shows a substantial gain in strength at 28 days and 6 months over that at 7 days.

(2) The times of initial and final set are delayed by the addition of oil; 5 per cent of oil increases the time of initial set by 50 per cent and the time of final set by 47 per cent.

(3) The crushing strength of mortar and concrete is decreased by the addition of oil to the mix. Concrete with 10 per cent of oil has 75 per cent of the strength of plain concrete at 28 days. At the age of 1 year the crushing strength of 1:3 mortar suffers but little with the addition of oil in amounts up to 10 per cent.

(4) The toughness or resistance to impact is but slightly affected by the addition of oil in amounts up to about 10 per cent.

(5) The stiffness of oil-mixed concrete appears to be but little different from that of plain concrete.

(6) Elasticity.—Results of tests for permanent deformation indicate that no definite law is followed by oil-mixed concrete.

(7) Absorption.—Oil-mixed mortar and concrete containing 10 per cent of oil have very little absorption and under low pressures both are waterproof.

(8) Permeability.—Oil-mixed mortar containing 10 per cent of oil is absolutely water-tight under pressures as high as 40 lb. per sq. in. Tests indicate that oil-mixed mortar is effective as a waterproofing agent under low pressures when plastered on either side of porous concrete.

(9) The bond tests show the inadvisability of using plain bar reinforcement with oil-concrete mixtures. The bond of deformed bars is not seriously weakened by the addition of oil in amounts up to 10 per cent.

Note.—A public patent has been granted for mixing oil with Portland cement concrete and hydraulic cements giving an alkaline reaction, and therefore anyone is at liberty to use this process without the payment of royalties.

SAN FRANCISCO TRANSPORTATION PROBLEM.

Preliminary Report No. 7.—Part 1.—Improvements in Rolling Stock.

BY BION J. ARNOLD.

[Concluded.]

For a Future Standard Car.

(14) Over-all width 8 ft. 6 in., track centers not less than 10 ft. 2 in., (sidewalk width 12 ft. on 68 ft. 9 in. street), giving two-line vehicle traffic on all streets.

Note.—It is understood that the United Railroads now has in contemplation the following modifications of the original plans:

(1) Moving front exit gate next to bulkhead.

(2) Cleveland's arrangement of fare box and guide rail.

(3) Cross seat cushions 17 in. x 34 in.

(4) Bulkhead posts to be flared back to increase shoulder width at entrance.

(5) Sliding or folding step.

(6) Storm curtains, if satisfactory on Geary Street cars.

(7) Ventilating intakes if found necessary.

(8) Removal of fare box from entrance way.

(9) Vertical stanchions in closed compartment set out to knee line.

(10) Platforms to be tapered, when improved type of fender is developed.

Discussion.

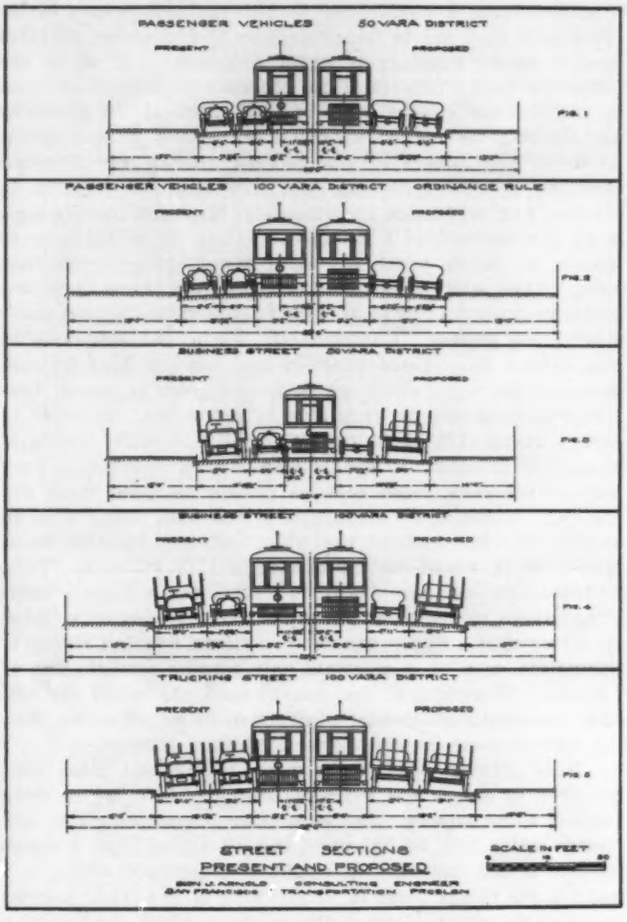
Seating Arrangement: In the Geary Street cars I have preferred to locate the principal storage space in the open section, while the reverse is true in the United Railroads design. My reason for so doing is in recognition of the fact, which I have determined by observation, that the average passenger rides less than two miles along a given route before alighting. This means that the shorthaul passengers greatly predominates, and consequently that extra space must be provided for persons disinclined to move forward because of a short trip ahead.

On the other hand, the United Railroads provides this extra storage space by using longitudinal seats in the closed section to encourage people to move forward in order to clear[1] the rear part of the car for new-comers, and also for the reason that during stormy weather, longitudinal seats will accommodate the maximum number of persons desiring to be protected. However, the United Railroads design provides no sash in the open sections, nor storm-curtains as does the Geary Street car. It is possible that the storm-curtains for the latter may not prove a perfect appliance for this purpose, but in the absence of something better I certainly should not consider it wise to spoil such a good seating arrangement as in the Geary Street cars on account of a short period of inclement weather.

One method that occurs to me of encouraging passengers to move forward is to limit smoking, by ordinance, to the front open section, thereby inviting forward a fair proportion of the passengers immediately after entrance. The serious objection to the United Railroads layout is that the passengers entering the car body are immediately forced into the center of the aisle, counter-current to those passing out through the rear exit. On the other hand, the side seat plan as used in the Geary Street car provides not only a relatively wide passageway, but also an offset aisle which will tend to separate lines of entering from leaving passengers.

Experience in other cities tends to show that longitudinal seats do not attract street car patrons—cross seats, quite the reverse. Consequently, the advisability of thus using all longitudinal seats in the center or closed section is very doubtful, especially with so wide a car as here proposed. The fact that riding in San Francisco is extremely short-haul justifies the use of a certain percentage of longitudinal seats; but they should be placed where most needed, and in this respect the Geary Street car design is in my judgment the more desirable for the present car. The best that can be said of the United Railroads seating arrangement is that it is a considerable improvement over some of the present equipment, with the exception of the so-called Chicago car, which may be identified by class numbers 1500 to 1549, and the half cross, half longitudinal seat type, represented by class numbers 1550 to 1749. In the latter, the longitudinal seats run as far

[1]As a matter of fact, the contraction of the aisle at the ends instead of the center tends to defeat the very purpose in view by checking free forward movement right at the entrance.


PASSENGER VEHICLES 50 VARA DISTRICT
PRESENT
PROPOSED
PASSENGER VEHICLES 100 VARA DISTRICT ORDINANCE RULE
BUSINESS STREET 50 VARA DISTRICT
BUSINESS STREET 100 VARA DISTRICT
TRUCKING STREET 100 VARA DISTRICT
STREET SECTIONS
PRESENT AND PROPOSED
SCALE IN FEET
BION J. ARNOLD CONSULTING ENGINEER SAN FRANCISCO TRANSPORTATION PROBLEM

Diagrams of Street Sections.

Present and Proposed Arrangements Compared in Each Diagram.

1. Standard street, 50-Vara—Western Addition district. Two car lines and passenger vehicles only. With present 15-foot sidewalks, only one line of vehicle traffic possible. With narrower car (i.e., 8 ft. 6 in.), and sidewalk reduced to 12 ft., two lines of traffic are possible. This condition impossible with wider car.
2. 100-Vara—Mission District; with standard ordinance width of sidewalk—19 ft.—two-line passenger vehicle traffic possible only with narrower car. In this district, however, the sidewalks have been reduced by special ordinance on most of the important streets.
3. Business street, 50-Vara District. Two car lines barely permit single line traffic for freight vehicles. But with single car track, two-line traffic can be secured by reducing the sidewalk width to 14 ft. Two-line mixed traffic impossible with either car and present standard width of sidewalk. 12-ft. sidewalk, as proposed in 1, would permit two-line freight vehicle traffic with narrower car, but hardly with wider car.
4. Business street, 100-Vara District, showing actual sidewalks. Two line mixed traffic possible with either narrow or wide car. Nine inches greater margin or clearance with narrower car. This shows most efficient utilization of 9 ft. 2 in. car in the district where wide streets occur, such as Mission Street, as referred to in conclusion of this report.
5. Heavy trucking street, 100-Vara District. Sidewalk 15 ft. in width, as established by ordinance, does not permit two-line vehicle traffic with double-track car line. By reducing sidewalk to the usual standard—one-sixth of street width—two-line vehicle traffic is possible with narrow car, but not with wide car. This condition typical of Howard Street, which has been set aside for heavy trucking through the Mission. Using the present standard track centers—11 ft. ½ in.—two-line heavy vehicle traffic can only be secured by cutting sidewalk to 13 ft. 7 in. for the narrower car, or 13 ft. 3 in. for the wider car.

as the center of the car on the one side, then for the remainder of its length on the other side, thus approximating the Geary Street arrangement except for the central closed section.

Width of Car. As a result of experience and observation in Chicago during the complete rehabilitation of the transit system, it would seem that the adherence to a car as wide as 9 ft. 2 in.[2] in San Francisco is a mistake, provided that a future standard is under discussion. If all of the streets of your city were of the generous proportions of those of the business district south of Market Street, the necessity for limiting the car width would not arise. Unfortunately, however, the streets of the 50-Vara district and Western Addition are, as a general rule, only about 68 ft. 9 in. in width. And, still more unfortunately, the track centers have been standardized at a distance of 11 ft. ½ in. in order to secure an ample width of "devil strip"—22½ in. between cars. This width undoubtedly represents good practice, although a width of 20 in. is sometimes sufficient where street widths are limited. Unfortunately, again, the sidewalks in the 50-Vara district and Western Addition are fixed by ordinance at 15 ft. in width, which is too great to permit two-line vehicle traffic on each side of the street. In order to secure reasonably rapid transit, two-line vehicle, traffic is absolutely essential, to enable slow-moving vehicles to keep next to the curb, rapid vehicles passing between them and the car. If the usual proportion in sidewalk width were in vogue, viz.: one-sixth of the width between building lines, the sidewalk would be approximately 11½ ft. wide. Then with the narrower car—8½ ft. in width—and a 20-inch "devil strip," there would be ample room for two lines of vehicles on either side. Under present conditions two-line traffic is impossible, as a 15 ft. sidewalk only permits a single line of vehicles. Therefore, at the present time, the wider car will offer practically no greater obstruction to street traffic than the narrower car, in the Western Addition District.

It is entirely possible, however, that future steps may be taken to reduce the width of sidewalks in order to clear some of these streets. And in addition, considering the new streets which will be improved and electrified from time to time, it is not too early to establish a standard which will make these things possible. Narrowing of the track centers in order to require less of the roadway width than at the present time must be effected to carry out this plan. This can only be done gradually on extension and rehabilitation work, but ultimately the entire city will be brought to one standard.

For an 8 ft. 6 in. car, 10 ft. 2 in. track centers may be used, as is the present standard within the City of Chicago. This combination makes available 18 in. more of roadway than under present conditions. The desire of the United Railroads to furnish the maximum width of aisle by using the wider car is indeed laudable, but when it is considered that the wider car is obtained at the expense of narrowing the roadway, I cannot recommend it, especially when a width of aisle, 28 in. between seat backs, has proven sufficient in so congested a city as Chicago.

Seats. The seat proportions proposed do not appear to be liberal enough, especially for so wide a car. For comfort, cushions should be 17 in. x 34 in., and all seats in the car spring-backed. This requires a longitudinal spacing of at least thirty in., preferably more. In the 1912 car, the dimension of the closed section has resulted in cramping the spacing of cross seats in the open sections to 29 in. This should be increased. The size of the closed section is determined by the number of seats and the spacing allowed per person. Although the design calls for 17¾ in. per passenger, which is fair, the effective spacing has been reduced by the provision of vertical hand rods or stanchions at alternate seats, extending from the floor to the roof at the seat line. These hand rods reduce the actual spacing between stanchions to 34 in., which is not sufficient to allow two persons to ride together comfortably. Moreover, these stanchions in the present position will probably prevent uniform seating, inasmuch as there are no fixed divisions between the seats. They require six inches additional length in the closed compartment, which if applied to the open compartments, would increase the seat spacing to thirty in.—some improvement over the present spacing.

However, where longitudinal seats are used, these stanchions are desirable in place of straps, for the assistance of standing passengers, and if covered with white enamel as in modern rolling stock, they are sanitary and convenient. But in the absense of a more liberal spacing, they should be set out at least to the knee line, in which position they would interfere less with seated passengers, and would be fully as convenient for standing passengers as in the present plan. Without very liberal seat space per passenger, partitions must be used between seats if stanchions are to be set up against the seat line, and either condition requires so much extra length of car body that the number of cross seats in the open sections is reduced from six to four. Therefore, with this car body I should prefer the standard cross-seat arrangement within the closed section, or else the dimensions should be so modified as to obtain better results in both compartments.

Length of Car. This is limited by the permissible overhang of platform beyond the center line of trucks, and that of the projecting fenders used. On general principles, it is desired to increase the length of car body as much as possible, in order that the proportional cost of platform wages may be reduced and also the relative maintenance of parts. But, in any case, the platform overhang is the serious and determining factor, especially where narrow streets are encountered, owing to the resulting interference with adjacent car and vehicle traffic on curves. For prepayment cars, long platforms are necessary, and in order to reduce the overhang of the ends, trucks must be located as far apart as possible, and still keep the center overhang within reasonable limits.

In the case of the 1912 type of car, the proportions have been worked out to secure probably as good a design as could be produced under the conditions existing in this city. The distance between truck centers and car platforms is practically the same as in the Geary Street car. In either design, the end overhang cannot be reduced because of interference of trucks with the projecting underhanging platform side sills. In reasonably flat cities, two-motor, maximum traction trucks, with pony wheels extending out under the platform can be used, thus decreasing to some extent the platform overhang. But in San Francisco, two-motor equipments are impossible on account of the greater tractive effort required on heavy grades.

The only remaining method of reducing car overhang is by tapering the platform so that the corners of the bumpers describe an arc of somewhat shorter radius. In this respect, I cannot recommend the 1912 car, because of the fact that the platform has been designed of the same width as the car body on the assumption that with the use of a fender, the platform actually presented less overhang around curves than the corner of the fender, which now prevents clearance operation. But even assuming that this is true, it should not be assumed that the present type of fender is to be permanent.

Clearance operation is very essential in any system of rapid transit, surface or otherwise, and it is a fact that through the adoption of the "Eclipse" fender, specified by the Board of Supervisors, the clearance operation of cars around curves in San Francisco has been entirely nullified. Nevertheless, I feel that the development of a new car for either present or future should not embody this purely temporal condition and render clearance operation impracticable

[2]Width over belt rail 9 ft. 8 in., over body 9 ft. 0 in.

or dangerous. Consequently, tapered platforms should be embodied in the design. The only alternative is for the city to permit the spreading of tracks at curves sufficient to clear present fenders, which would result in an overhang of 15 in. over the standard curb of the Western Addition district.

Platform Arrangement.[3] .Generally speaking, there is a certain relation between the area occupied by passengers in the car body and that of the platform; i.e., the larger the car, the more platform space is required. Where the prepayment principle is used, it is particularly necessary that ample storage space be available on the platform in order to avoid delaying the schedule due to slow loading, as would be the case with the short platforms. Moreover, every restriction placed in the way of free entrance of passengers must be removed. In the 1912 car, the principal difficulty is this contraction of the entrance space—first, by cramping the railing into the entrance passageway; and, second, by locating the controller directly opposite the contraction. There are three ways of improving this defect:

First: By straightening out the guide railing so as not to cramp the entrance way;

Second: By use of the master control system; and

Third: By placing the fare box next to the bulkhead and in the center of the opening, with the conductor immediately behind it standing on the car body floor.[4]

With the remote control system, only a very small master controller box is necessary on the platform, while the actual contact devices, connected thereto by an electric circuit, are all located underneath the car.

In the third method the present form of guide railing is entirely dispensed with, the guard rail for the fare box serving the purpose of dividing the bulkhead opening into entrance and exit passages. In this manner, the entire platform is open to passengers and the congestion at the entrance entirely eliminated.

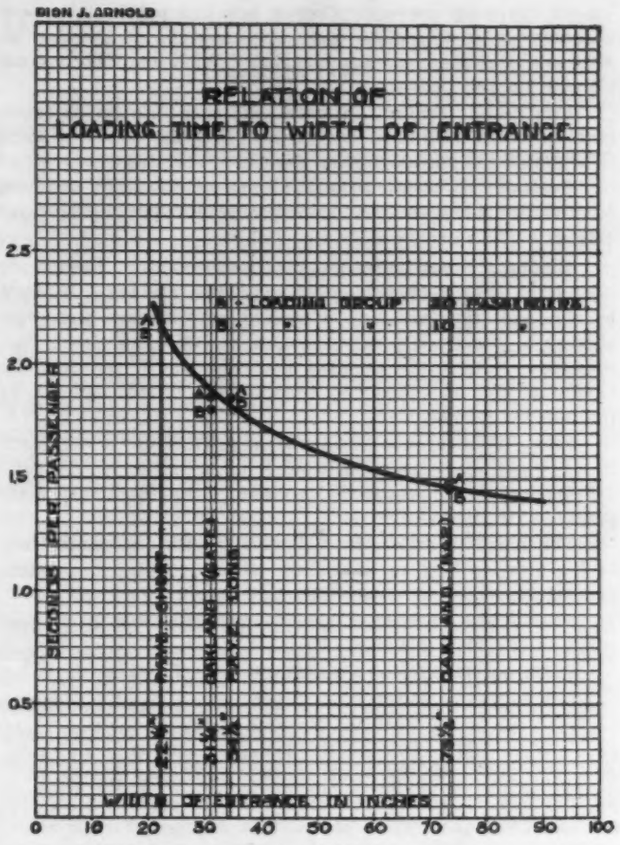
For the new rolling stock, one or more of these methods should be adopted; and in any case, the front exit gate should be removed from its present location next to the bumper to a position next to the bulkhead. This, in my judgment, is more desirable, so that passengers may alight quickly without having to force their way through standing groups which at present congest the space between the bulkhead and front exit gate.

By using the master control system as above proposed, and with the handrailing straightened, fully 50 per cent more entrance width will be available.

An advantage of the proposed location of exit gate next to the bulkhead is that two or three feet of length may be saved from each two-car safety station[5] along Market Street. At Kearny Street station particularly, this is of importance, owing to the difficulty in securing the proper length of station without interfering with street traffic.

In carrying out these improvements, the bulkhead should be left open with the maximum width between corner posts, in order to secure ample entrance and exit space. This is a definite advantage of the so-called "California" type of car, and the entrance and exit should not be contracted by false bulkheads such as wire screens or vertical railing.

Loading. San Francisco cars, unlike those of other cities, are called upon to handle two entirely different classes of service: (1) normal street traffic; and (2) terminal traffic at the Ferry, and it is the difficulty in handling large groups of passengers at terminals that has occasioned most of the recent criticism. In my judgment, the prepayment is by far the best system of operation that has been devised thus far,



Effect of Entrance Width on Loading Speed of Car.

6. Based upon observations of car loading, showing the relative time required to load a given group of passengers through wide and narrow entrances. For comparisons of this kind, the same sized group must be used, otherwise the comparison is valueless. These results conform in character to similar observations made upon different sized cars in Chicago. The data shows that the largest San Francisco platforms now in use requires 27 per cent more time in seconds per passenger than the Oakland cars using the radius rod.

but it must be perfected for these special conditions of service.

More rapid loading at points of congestion can be secured by the use of a radius rod in the guide railing, such as first used on the Oakland cars, and which has been adopted by the Geary Street car. By means of this radius rod, the entire width of step can be made available so as to increase the storage space at entrance, and thus load large groups of passengers more promptly than if half the step were used.

As an alternative, the radius bar may be omitted and the hand railing cut off about 24 in. back from the step, in a measure accomplishing the same purpose. This plan is now in use on some of the United Railroads cars.

Still another method of accomplishing the same result is by changing the position of the conductor's stand from the platform to the entrance of the car body as previously described, and by the elimination of the present form of guide railing. By this arrangement not only is the full step width made available for entrance, but the entire platform area can be used as storage space for passengers waiting to pay their fare.

A graphical demonstration of this relation between loading speed and width of entrance is afforded by Fig. 6, based upon observations on different widths of entrance at the step line. It will be seen here, that the long platforms of San Francisco require approximately 27 per cent more time in seconds per passenger than the Oakland car, using the full width entrance with the radius bar swung over to the bulkhead.

[3]Note.—With standard spiral casements at present used throughout the United Railroads system, the 1912 car theoretically clears on curves with a margin of four to six inches on the wider streets, and one to two inches on the narrower, exclusive of fender. But even this maximum clearance is out of the question on account of the possible list of the car on curves from various causes, such as eccentric loading, depressed rail, worn side bearings, failure of springs, etc.

[4]This plan is at present in operation in Cleveland.

[5]Recommended in Report No. 6.

At the Ferry and other heavy terminal points, it is very necessary that the platforms at both ends of the car be available for prepayment entrances. This may be accomplished in two ways:

First: By turning the front exit gate into an entrance gate, in which case only half of the full width between posts is available for entrance after the car is emptied.

Second: By opening the blind side of the front platform for the full width between posts for rapid exit, using front exit gate for entrance only.

Height of Steps. The height of steps involves many more details of design than appear upon the surface. In fact, to eliminate the last inch of height may require the redesigning of the trucks, bolsters, and car underframing. Furthermore, it must be recalled that any figure representing height of step is subject to considerable fluctuation due to the following causes:

First, after usage, the truck springs show a tendency to set, which may amount to from ¼ to ½ in.

Second, under maximum car load, the springs may compress 1¼ to 2½ in.

Third, due to wear, the wheel diameters decrease from 34 in., new, to 31½ in. maximum wear, dropping the entire car 1¼ in.

Fourth, due to wear of side bearings, steps may vary as much as one inch in height.

Fifth, permanent sag in platform underframing.

Due to one or all of these causes, the step of a properly designed car may drop from 2 to 4 in. from its position when new. Were the car originally designed with this low step, wear and stress would result in the platform lowering to a point where it would interfere with the operation of the trucks. Consequently, to secure this necessary truck clearance, the new cars must be designed with proportionately high steps.

The 1912 car submitted by the United Railroads appears to show careful design with respect to this step height, and the cars, when new, will have the first step about 15 to 16 in. from the pavement, which may eventually be reduced to 12 in. by wear and settling.

In the Geary street car, a simple device was made use of to reduce the height of step between platform and car body, in which the car floor was inclined from the center line of the bolster toward the end sill, so that the platform step is two inches lower than it would be with the level car floor. It is understood that this plan will also be adopted in the 1912 car, except that the platform instead of the floor will be sloped upward two inches in the form known as a ramp.

I regard it as very necessary that folding steps be used in the place of fixed steps. The object of the folding step is two-fold:

First. Lifting the steps on the blind side of the car will tend to discourage persons from endeavoring to steal a ride, and thereby incur the liability of accidents, as is the case when the steps are down.

Second. This practically obviates the possibility of collision or other interference with passing vehicles.

With the large number of overhanging steps now being operated in San Francisco, the danger from these two sources will be appreciated. In some pre-payment cars, designers have even gone to the length of automatically raising the steps when the vestibule door or gate is closed, so that while in motion, the car is entirely stripped of steps in the lowered position. Cars of this type may be found on the College Avenue line, Oakland, and in Boston and other cities.

Ventilation. Without having positive knowledge of the operation of the ventilating funnel shown on the 1912 car, I believe it should operate with fair satisfaction when the car is in motion. The principal objection I find is that there is no provision for the ventilation of the closed section while the car is standing still, and in this respect the Geary Street car is superior, in the use of the floor intakes by means of which natural circulation is provided for.

It is unquestionable that the fixed sash will result in slightly lower maintenance expense, but there will be times when it will be necessary or desirable to open the windows of the closed section. The Geary Street cars have raised sash, which I prefer to drop sash, on account of the increased cleanliness and the fact that the decreased thickness of wall may be taken advantage of for increasing the width of the aisle.

In conclusion, the 1912 United Railroads car may be regarded as a step in the right direction, and in general a considerable improvement over any of the types at present in operation here. It will prove fairly satisfactory for certain sections of the city where streets are wide enough to accommodate a wide car, as in the Mission.

Some features are quite commendable, such as the use of the turtle-back or arched roof and the position and type of illuminated signs; also the lowering of the steps by means of a platform ramp.

But if the design is intended for universal use throughout the city, or a standard for future equipment is under consideration, this car will require considerable modification, as outlined in the preceding discussion.

WATER-POWER DEVELOPMENT IN MEXICO.

A 99-year concession has been granted by the Mexican Government to D. J. Spillane, of San Luis Potosi, to take 50,000 liters per second from the Santa Maria River and 25,000 liters per second from the Gallinas River for power purposes. The works will be built within the territory extending from a point on the Gallinas River 2 kilometers above its junction with the Santa Maria River and on the Santa Maria from a point 10 kilometers above its junction to 2 kilometers below the junction. Plans of the location must be completed before May 20, 1913, and plans of the hydraulic works must be submitted before May 20, 1914, and work must begin within two months after approval of the plans by the Secretary of Fomento and to be completed within five years thereafter. The concession limits the prices which may be charged for power within 5 kilometers of the plant to 110 pesos per horsepower per annum, except for motors of 50 horsepower or less; for any distance greater than 5 kilometers from the plant prices may be increased by 10 per cent of the cost of installing the additional service. The company is exempted from taxes for five years with free entry of equipment. The concession may not be transferred to any foreign company or state.

It is understood that a company has been formed in the United States which has purchased the concession from Mr. Spillane, together with some 25,000 acres of land adjacent to the falls. The fall at the junction of these rivers is 106 meters. The falls are said to measure a normal flow of 40,000 horsepower, with excellent facilities for increasing the power by storage to more than 100,000 horsepower.

ELECTRICAL REPORTS FOR JUNE AND FOR THE FISCAL YEAR 1911-12.

The Bureau of Statistics of the Department of Commerce and Labor, Washington, D. C., has issued its monthly summary of the imports and exports of the United States for last June and, therefore, also its annual summary for the fiscal year ended June 30, 1912. From these statistics the following data on the exports of electrical products are obtained.

Due to the usual fluctuations from month to month, the figures for June show a falling off from those of the preceding month in both classes of electrical shipments, appliances (instruments and miscellaneous small apparatus) and machinery (heavy articles). This was not to be wondered at as regards the appliance exports, for those of May were extraordinarily large, breaking all previous records. The following table shows strikingly the monthly fluctuations in each class and in the totals during the past fiscal year and in June of a year ago:

Month.	Electrical Appliances.	Electrical Machinery.	Total.
June, 1911	$ 884,839	$825,091	$1,709,930
July, 1911	707,214	584,715	1,291,929
Aug., 1911	725,145	666,544	1,391,689
Sept., 1911	841,769	658,831	1,500,600
Oct., 1911	851,650	583,000	1,434,650
Nov., 1911	955,706	723,860	1,679,566
Dec., 1911	1,168,612	910,601	2,079,213
Jan., 1912	1,045,636	675,633	1,721,269
Feb., 1912	968,626	672,676	1,641,302
Mar., 1912	1,081,895	751,785	1,833,680
Apr., 1912	923,631	820,385	1,744,016
May, 1912	1,349,800	718,546	2,068,346
June, 1912	1,104,815	678,287	1,783,102

The following totals for the last six fiscal years, each including the twelve months ending June 30, show very conclusively the general trend of the electrical export trade. Among points of particular interest may be noted the marked slump of 1908 and 1909 and the excellent recovery therefrom in the more recent years, particularly in appliance exports, which have nearly doubled in the last three years and have since held the lead over the machinery shipments.

Year.	Electrical Appliances.	Electrical Machinery.	Total.
1906-07	$ 8,262,640	$9,005,766	$17,268,406
1907-08	6,754,217	8,495,219	15,249,436
1908-09	6,074,865	6,449,526	12,524,391
1909-10	8,694,132	6,048,263	14,742,395
1910-11	10,702,827	8,024,628	18,727,455
1911-12	11,724,499	8,444,863	20,169,362

Reverting back to the figures for last June, the principal countries to which electrical shipments were made and the values of these exports are given below:

Countries.	Electrical Appliances.	Electrical Machinery.
United Kingdom	$ 38,202	$ 46,646
Canada	352,371	190,743
Mexico	103,121	90,370
Brazil	240,797	41,739
Japan	109,494	87,887
Total	$843,985	$457,385

The first direct communication between the Mare Island Navy Yard of California and the recently completed Pribyloff wireless station in Alaska was established recently. The operators conversed freely over the distance of 3100 miles. The Alaska station has just been overhauled by wireless experts from Mare Island.

VISITING-MEMBER PRIVILEGES WITH FOREIGN ELECTRICAL-ENGINEERING SOCIETIES.

For some time past the Board of Directors of the American Institute of Electrical Engineers has desired to promote closer relations between the Institute and foreign electrical engineering societies. The advantage of a closer understanding was especially felt last year, when so many Institute members went abroad to attend the International Electrical Congress at Turin, and the meeting of the International Electrotechnical Commission. On receiving the report of Gano Dunn, who as president of the Institute headed its delegations to both of these meetings, the Board, feeling that it would not only promote mutually the convenience of visiting engineers both to this country and abroad, but would also increase the friendly relations which are constantly growing through the activities of the International Electrotechnical Commission and other similar agencies, passed the following resolution:

Resolved, That the President is authorized to communicate with certain leading foreign electrical engineering societies with respect to establishing mutual visiting-member privileges for a limited term, with the end in view of contributing to the convenience of our own members visiting foreign countries, and, in return, affording corresponding conveniences to members of foreign electrical-engineering societies visiting the United States, and of increasing the friendly relations between American and foreign engineers.

Accordingly a number of European electrical engineering societies were communicated with by President Dunn, and the following have cordially accepted the Institute's proposals to enter into reciprocal arrangements:

Institution of Electrical Engineers (Great Britain), Verband Deutscher Electrotechniker (Germany), Societe Internationale des Electriciens (France), Associazione Elettrotechnia Italiana (Italy), Koninlijk Instituut van Ingenieurs (Holland), Association Suisse des Electriciens (Switzerland). The Svenska Teknologforeningen (Sweden) will take up the question at the meeting of its governing body in the fall.

The arrangements entitle members of the Institute of Electrical Engineers while abroad to the privileges of members of the societies designated, for a period of three months, and foreign members visiting this country are entitled to the privileges of Institute membership for a like period.

To foreign engineers visiting this country it is proposed to give, upon presentation of proper credentials, letters of introduction to Institute members and to officers of manufacturing and operating companies; also to place at the disposal of visitors the facilities of the library, in which are a large number of books in foreign languages, and the reception, reading and writing rooms at Institute headquarters. Visitors may also have their mail received and forwarded.

There has been prepared for the use of Institute members while abroad a form of certificate to be signed by the secretary, which will serve as credentials from the Institute to foreign societies. A separate certificate is necessary for each foreign society.

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POWER AND GAS

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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

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Electrical Exports

The electrical activity of Canada to the north and Mexico to the south has been noted considerably in these columns of late. Especially has this activity made itself manifest in Western Canada. On a previous occasion mention was made of the fact that a gigantic demand for electrical apparatus would inevitably come in the near future from the reawakening of China. Indeed this reawakening is already being anticipated by American manufacturers in an endeavor to secure a firm foothold in the neighboring country of Japan. A summary of the electrical exports for the past year may be found on another page. Western men will be interested in noting that of the principal countries to which electrical appliances were shipped during last June, for instance, 74 per cent went to either Canada, Mexico or Japan, while 81 per cent of the shipments in electrical machinery was exported to these countries. Examining more closely we find that of the 74 per cent in electrical appliances 46 per cent went to Canada, 14 per cent to Mexico and 14 per cent to Japan, while of the 81 per cent in electrical machinery 42 per cent went to Canada, 20 per cent to Mexico and 19 per cent to Japan. The outlook for continued electrical activity with our Western neighbors is indeed promising.

Water Development for Western Cities

Western municipalities, anticipating continued prosperity and a growth in proportion to past realizations, are truly active in their efforts to solve the problem of adequate water supply.

Portland was the first Western city of large proportions to look to the distant snow-capped mountains for the charms there to be enjoyed and captured by developing a pure and wholesome natural domestic supply. The reduction of a rather startling death rate to a rate considerably lower than other cities of its size was the immediate result. But far more than this material accomplishment is the civic pride engendered in every citizen of Portland when he turns his eyes to the Mecca of the Rose City—Mt. Hood—whence issues this ideal supply.

Los Angeles, in accord with its traditions of the past, is soon to give to the world another record-breaking accomplishment, that of the Los Angeles Aqueduct.

The bringing of water, now losing itself in a sunken lake, but soon to pierce the dizzy mountain peak and cross the burning deserts, to that city—a distance of some 240 miles—is a municipal triumph which deserves the reputation the feat enjoys at the present time. The clock-like accuracy with which the gears and ratchets of the aqueduct organization are working is no less a triumph, however, than the actual material feat itself. Indeed, the two other cities—Seattle and San Francisco—which are now planning their water supply in the embryo, may well look to the organization of the Los Angeles Aqueduct for pointers in planning the future undertaking.

Cedar River, from which Seattle plans to obtain its domestic supply, has as a lowest recorded run-off in years between 1903 and 1911 a supply sufficient for the needs of a city of 1,306,000 people at an average daily consumption of 100 gallons for each inhabitant. Further than this, if, when needed, impounding dams are constructed to hold the surplus waters during seasons of largest flow, it is possible to make ample provision for the supplying of a city of 3,920,000 people from this same source. Seattle has shown foresight in securing the control of the entire watershed of this pure and beautiful stream, thereby enabling the proper authorities to protect it from the possibility of contamination.

San Francisco, on the other hand, is considering a scheme far more audacious than even that of the Los Angeles Aqueduct. According to the advice and investigation of its consulting expert, John R. Freeman, it is proposed to bring water from the Hetch Hetchy valley by means of a gravity system throughout and in sufficient quantity to supply not only San Francisco and its estimated growth for the next three generations, but all the cities about the bay region—Oakland, Berkeley, Richmond, Alameda, San Jose—are invited to join in the enterprise. In the ultimate the scheme will provide water sufficient for 6,000,000 people on the 100 gallon per capita basis and in addition the several drops en route will be of sufficient proportions to develop 100,000 horsepower.

Such gigantic enterprises, hitherto, ungrappled with by municipal authorities, may well be guided by the words of George Westinghouse: "It is cheaper to buy experience than to manufacture it." The recent appointing of M. M. O'Shaughnessy, the well-known water expert, at an unprecedented salary in San Francisco engineering administration as city engineer of San Francisco, is a happy augury for the promotion of the successful accomplishment of the big enterprises ahead.

The Arnold Report on Car Design

The transportation problem of San Francisco is more than of local interest. Our readers will find elsewhere in this issue the conclusions of Bion J. Arnold relative to improvements in proposed rolling stock for the Exposition City.

In a comprehensive discussion of the modern street car, seven topics must necessarily enter in the argument—seating arrangement, facilities for quick loading and unloading, storage space, car proportions, height and type of steps, ventilation and lighting, and designating signs. Of these seven features, seating arrangement, height of steps, and ventilation enter more toward the personal comfort of the public than any others. In the recent growth in heavy enclosed steel rolling stock the last point mentioned above enters profoundly into comfortable transit considerations during overload periods of traffic congestion.

The editorial staff of this Journal have taken considerable pains to collect data on this subject during the past year from as widely varying sources as possible, both in San Francisco and the cities about the bay. Our conclusions are that so far as the cross-seat versus the longitudinal arrangement is concerned the traveling public have little patience or sympathy with the latter mode of seating. The rapid acceleration or deceleration of cars gives such a decided discomfort no pleasure is to be found in cars where many stops are made and seating of this nature wholly predominates. The design submitted by Mr. Arnold proposes more cross-seats than the United Railways design and is truly to be commended in this regard.

While the hobble skirt still continues to limit the tractive effort of many of the new voters in California, yet as a whole Western common sense has predominated among our women in this regard—at least to such an extent that the delays due to the out-of-reach step can not be said to be due to this mode of dress, for the careful observer will note that the painful puffing and blowing in climbing into the car comes as much from those of the sterner sex as from the women. The authorities of the United Railroads in proposing to reasonably lower the necessary lift at the entrance of the new car are to be commended for their attitude.

The most crying evil, however, in recent car design is that of almost criminal neglect in ventilation. The solid steel car is undoubtedly safer in accidents and from nearly every other point of view is to be hailed with joy when put into operation by an enterprising traction company. Yet how wofully far short do these cars fall many times in the eyes of the traveling public! To find the cause ask varying groups of those utilizing this conveyance and practically a unanimous verdict will be rendered that ventilation has been frightfully neglected in modern car design. In his report Mr. Arnold states that, without having positive knowledge of the operation of the ventilating funnel shown on the 1912 car, he believes it will operate with fair satisfaction when the car is in motion, though he finds no provision for ventilation while the car is standing still. A beautiful and emphatic lesson in ventilation may be learned by riding upon the new enclosed steel cars of the Telegraph avenue line of the Oakland Traction Company. Here is a line feeding the next to the largest university in America, a line where seven thousand students might learn the best that is in modern traction evolution. Ten years ago this line was abreast of the times and with pride pointed to by thousands of visitors, and yet today with its jostling, jolting longitudinal seats and its dense, unwholesome air in the enclosed section, many are prone to avoid going from Berkeley into Oakland, preferring to cross over into San Francisco rather than endure the torture offered them in taking this formerly beautiful and instructive ride.

In contemplation, then, of the new car design for San Francisco, positive information should be gathered on this important subject and every effort made to induce the salubrious atmosphere of the Bay City to enter the enclosure.

PERSONALS.

J. J. C. Forney, a telephone official of Los Angeles, is a recent San Francisco visitor.

H. E. Greer, is a delegate from Spokane to the meeting of the National Association of Stationary Engineers at Kansas City September 9 to 14.

J. C. Love, assistant superintendent of meters of the Sacramento division of the Pacific Gas & Electric Company, is a recent San Francisco visitor.

H. R. Noack, president of Pierson, Roeding & Co., recently returned to San Francisco after spending his vacation in a tour of the Pacific Northwest.

H. C. Goldrick, Pacific Coast manager for the Kellogg Switchboard & Supply Company, has returned to San Francisco after a tour of Nevada.

B. M. Mehl, in charge of maps and records of the Sacramento division of the Pacific Gas & Electric Company, spent last Tuesday in San Francisco.

A. E. Rowe, the San Francisco sales manager of the Telephone-Electric Equipment Company, has returned to San Francisco from an extensive vacation trip.

Dr. Ernst J. Berg, professor of electrical engineering at the University of Illinois, spent several days at San Francisco this week on his return from a visit to Japan.

James T. Whittlesey has resigned as chief engineer of the Public service Electric Company, Newark, N. J., to engage in consulting practice in San Francisco. Cal.

H. B. Squires, of the firm of Otis & Squires, will leave for Los Angeles next Monday and will, later attend the Pacific Coast Gas Association Convention at San Diego.

H. C. Vensano, civil engineer, with the Pacific Gas & Electric Company, left this week for the East to make tests on new designs of steel transmission line towers at the builder's factory.

Fred L. Webster, head of the Allis-Chalmers Company's Pacific Coast department, returned to San Francisco during the week from a brief business trip to Los Angeles, where a branch office is maintained.

Samuel B. Christy, dean of the school of mines at the University of California, has been appointed on the general committee to raise funds for the Kelvin memorial now being formulated by the great engineering societies of the world.

W. Scott, the general engineer of the Westinghouse Electric and Manufacturing Company, who is making a tour of the company's Pacific Coast branch offices, arrived at San Francisco during the week. He will visit Los Angeles next.

Chester H. Pennoyer, manager of the San Francisco agency for the National Conduit & Cable Company and the National Brass & Copper Tube Company, has returned from a business tour of the Pacific Northwest. He reports a favorable business outlook in his lines.

W. D. Donald of San Francisco has been appointed by the board of public works as an inspector of car construction. Mr. Donald's duties will be to see to it that the cars for the Geary Municipal road comply in every detail with the plans prepared by Bion J. Arnold.

A. B. Saurman, manager of the Standard Underground Cable Company's Pacific Coast department, has returned to San Francisco from Eureka after an automobile vacation tour of Mendocino and Humboldt counties with a party of friends. The hunting and fishing was excellent.

J. B. Lukes, representative of the Stone & Webster Construction Company, has returned to his San Francisco office from Los Angeles, where he met **S. L. Shuffleton,** who has general supervision of the construction and other work on the Pacific Coast. Good progress is reported on the Big Creek hydroelectric development.

Marsden Manson, the retiring City Engineer of San Francisco, was presented recently with a silver loving cup by the employees of the Bureau of Engineering Department of the Board of Public Works. Manson, who resigned his position account of ill health, will take a rest in the country.

Arnold Pfau, hydraulic engineer with the Allis-Chalmers Company, is on his way to Milwaukee after doing some important work in San Francisco, in connection with large hydraulic contracts that are pending.

A. W. Bullard, general manager of the Great Western Power Company, and **P. T. Hanscom,** the general superintendent, returned to San Francisco last Wednesday, after spending several days in an inspection of the construction work in progress at Big Meadows dam and Los Plumas power house. Seven hundred men are working on the dam and seventy-five on the power house extension. Concrete is being poured at both points and the low stage of water in the river permits of rapid work.

F. B. Gleason, who, for some years past, has been manager of the Western Electric Company's San Francisco branch, has just received the appointment as Far Eastern manager for that company, with headquarters at Tokio, Japan. He will be in charge of the company's factory at that point and will have general supervision of China and Japan territory. **P. J. Condict,** the present representative of the Western Electric Company in Japan, will return to this country. Mr. Gleason will leave San Francisco within the next two weeks and go to the Orient via Europe and the Suez canal. He will remain at his new post for a term of three years.

J. R. Bibbins, resident engineer for Bion J. Arnold at San Francisco, has returned from Sacramento after a preliminary investigation of the Sacramento electric railway problem. The Pacific Gas & Electric Company, which owns this road, on its own initiative has engaged Mr. Arnold to report upon these properties, this probably being the first example on the Pacific Coast of a public utility voluntarily instituting an examination of its properties without orders or other restrictions from municipal or State regulative authorities. As announced in these columns last week, this work will be of the broadest scope, covering in general the question of standards of service and equipment, improvements in the type of cars, the re-routing of cars, the development of better terminal facilities, especially at the railroad stations, the improvement in schedule speed and general operating conditions, and the possibilities of further extensions within the limits of a reasonable return upon the value of the property as determined by appraisal, which has already been made. The corporation has advised the Municipal Commission of Sacramento of its action and that it will ultimately place before the Commission the complete results of the Arnold investigation.

M. M. O'Shaughnessy has been appointed City Engineer of San Francisco to succeed Marsden Manson, resigned. The appointment was made by the Board of Public Works upon the recommendation of Mayor James Rolph Jr., who has practically given O'Shaughnessy carte blanche to do what is best for the city's interests, with authority to reorganize the City Engineer's department where necessary. Mr. O'Shaughnessy is 48 years of age and has resided in California 27 years. He is a graduate of the Royal University of Dublin. He first attained distinction in this State by serving as chief engineer of the Midwinter Fair at San Francisco. After the fair closed he became chief engineer for the Mountain Copper Company in Shasta County. Next he became chief construction engineer for the Crocker-Huffman Company, and built the irrigation dam on the Merced River. Later he was chief engineer for the Southern California Mountain Water Company constructing its aqueducts and plant, including the Morena rock-fill dam, the largest of its type in California. The city of San Diego is supplied with water from this system. As consulting engineer for no less than fifteen water supply plants in the Hawaiian Islands, O'Shaughnessy constructed four large aqueducts. The Throttle irrigation dam is another specimen of his work. O'Shaughnessy is a member of the American Society of Civil Engineers.

JOVIAN LUNCH CLUB OF SAN FRANCISCO.

The regular weekly lunch of the Jovian Lunch Club of San Francisco was held at Tait's Cafe on September 3 with an attendance of about sixty. T. E. Bibbins presided. The report of the nominating committee for officers for the ensuing year was adopted and the following declared elected: R. M. Alvord, W. W. Hanscom, F. H. Woodward, W. S. Hanbridge and F. H. Poss.

The membership committee reported that many desirable applications had been received for initiation at the rejuvenation on Jovian Day, September 10. Geo. C. Holberton entertainingly explained a magnificent collection of lantern slides illustrating the system of the Pacific Gas & Electric Company, particular emphasis being laid on the new work in Bear Valley.

PROGRAM FOR TWENTIETH CONVENTION PACIFIC COAST GAS ASSOCIATION.

The following arrangements have been made for the Twentieth Annual Convention of the Pacific Coast Gas Association to be held at San Diego, Cal., September 17th, 18th and 19th, 1912:

President's Address .....William Baurhyte

1. Commercial Gas Illumination .....W. T. Pease
2. Calorific Value of Oil Gas.....F. S. Wade
3. Welding of High Pressure Pipe Lines....Leon B. Jones
4. Quality of Fire Bricks for Use in Oil Gas Machines.. .....D. J. Young
5. Reasonable Gas Rates and Their Determination.... .....Prof. C. L. Cory
6. Perfect Service .....C. P. Houghton
7. Should Gas Companies Engage in the Sale of Appliances (Composite Paper)..L. H. Newbert, H. P. Pitts
8. Sale of Gas Appliances by a Small Gas Company.... .....F. A. Cressey, Jr.
9. Present Status of Gas Engineering in American Universities, and Some Suggestions for a Specialized Course on the Pacific Coast.....Prof. Robert Sibley
10. Wrinkles .....F. C. Millard
11. Experiences .....Wallace H. Foster
12. Novelties .....R. L. Clarke

The meetings will be held in the assembly room of the Grant Hotel, and will be called to order promptly at 10 o'clock a. m., September 17th.

Banquet: The banquet will be held in the Grant Hotel on Wednesday evening, September the 18th, at 7 o'clock.

On the evening of the banquet the ladies of the party will be the guests of the San Diego Consolidated Gas & Electric Company at a theatre party.

Outings: On Tuesday, September 17th, and Wednesday, September 18th, the ladies of the party will be entertained by automobile sight-seeing trips in and around San Diego.

On Thursday, September 19th, the members of the Association and ladies accompanying them will be taken in automobiles to all points of interest in and around San Diego as guests of the San Diego Consolidated Gas & Electric Company. The party will leave the Grant Hotel at 9 o'clock a. m. on this trip, returning to the Grant Hotel at noon, where luncheon will be served.

After luncheon, the party as guests of the United Light, Fuel & Power Company will be taken for a trip around San Diego Bay, returning to San Diego at 5 o'clock p. m.

On Thursday evening, September 19th, a ball will be given at the Grant Hotel by the San Diego Consolidated Gas & Electric Company for the members of the Association, ladies of the party, and invited guests.

TRADE NOTES.

Chas. W. Comstock, the well-known consulting engineer of Denver, has undertaken the position of engineering manager for the Goldsborough Company. In his new position, Mr. Comstock will have the general direction of all the engineering departments of the company.

The Dodds-Caffray Company, general sales agents, on September 1st, passed into the hands of The Electric Sales Company, who recently incorporated for the purpose of conducting a general electrical sales agency business on the Pacific Coast. Sales offices will be maintained at San Francisco and Los Angeles. W. C. Caffray is the president and general manager of the new organization.

Garnett Young, manager of the Telephone-Electric Equipment Company, reports that his Seattle office, F. G. Larkin, manager, has secured the awards of a Government contract for about two carloads of weather-proof wire and cables for the new electric lighting installations at Forts Ward, Flagler, and Worden on Puget Sound. The wire will be manufactured by the American Electrical Works, of Phillipsdale, R. I., represented by the Telephone-Electric Equipment Company.

It is understood that the Westinghouse Electric and Manufacturing Company will supply the main generators and other electrical equipment for one of the two power stations to be constructed on Big Creek for the Pacific Light and Power Company. Each of the two generators will be rated at 17,000 k.v.a., 6600 volts, at 279 r.p.m. As before stated in these columns, the General Electric Company was awarded the contract for two similar generators for the other power house and the Allis-Chalmers Company the water wheels for both plants.

J. H. Wise, assistant general manager of the Pacific Gas & Electric Company and the staff of engineers have been very busy during the past two weeks over the bids for the hydroelectric equipment for the new South Yuba development. A total capacity of 40,000 h.p. is to be provided for, and as a force of 1700 men is at work at the site of the plant no time will be lost unnecessarily in closing the remaining contracts. The steel towers were awarded to Milliken Bros., and the insulators for the tower line to the Ohio Brass Company.

NEW CATALOGUES.

The Westinghouse Electric & Mfg. Company have issued several new leaflets and folders. Folder 4230 entitled "How Westinghouse Small Motors Can Help You" is an attractive little publication describing with illustrations, some of the manifold uses to which small electric motors can be put. The views show actual installations in the home and in the shop of the small motors. The publication is intended for dealers and central stations, space being left for their name on the back. Leaflet 2457 covers Commutating Pole Rotary Converters. These devices are described and illustrated in detail and considerable interesting information is given covering their construction. Leaflet 3506, in a series of Westinghouse paper mill motors, has just been issued and covers motors for pulp mill service. Illustrations are shown of motors in operation and considerable interesting data is given as to the use of electric motors in this industry. Leaflet 2444 covers the equalizer flywheel hoisting sets used in conjunction with electric hoists. Application views together with the diagram of connections showing the liquid rheostat are also given. The leaflet also describes the system in which these devices are used. The No. 10 issue of "Small Motors" is devoted to several interesting stories of experiences enjoyed by various people with motors in the home. These stories are illustrated and furnish interesting advertisements for central station new business departments. Descriptive Leaflet 2359-A illustrates and describes the type SK direct current, commutating pole motors.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

INTERIOR TELEPHONE WIRING.

BY E. J. BURKE, M. E.

Low voltage interior wiring for telephone and telegraph has been very slowly granted the attention it deserves. This is partly due to two causes. In the first place the voltage and current on such lines is so small as to eliminate any possibility of arcing at a short circuit or ground and thus causing fire. There being no danger in using any method for putting up such interior wiring, telephone and telegraph companies were slow to consider the amount of time and energy wasted and consequent loss of money due to such careless methods.

In the second place, for a long time there was no really practical and effective driven wire support on the market which afforded the necessary mechanical protection.

At first the best driven wire support for such wiring was a small bare staple or double-pointed tack. This furnished a neat and apparently good support and was largely used for such interior wiring. The telephone companies were the first to discover that these bare staples, when driven over their twisted pair wires, would in a short time corrode. This corrosion of the metal would quickly destroy first, the cotton covering on the wire, then, the rubber covering and there you had a short circuit and the telephone in that particular house was out of commission. While the trouble was quickly remedied when found, it frequently required several hours' time of a high priced trouble hunter to locate it.

The telephone companies then adopted the method of driving the staples over one leg only of the twisted pair wires. This prevented short circuits caused by a wireman driving a staple too hard and cutting through the insulation on the wire but did not prevent the corrosion of the metal gradually destroying the insulation on both wires as before and causing short circuits and grounds which, until found and removed, put that particular telephone out of business.

A staple was needed having a firmly fixed insulating saddle under the head which would give the required mechanical protection to the insulation on the wire and prevent the insulation from coming in contact with and being destroyed by the bare metal of the staple. It is also necessary that this insulated staple should have good driving qualities, that is drive easily into woodwork of various kinds without splitting the wood or itself bending and skating and that the insulation should be so well fixed that it could not possibly fall out when the staple was being driven. As soon as such a staple was placed on the market it was at once taken up by the most up-to-date telephone companies which realized that their cost of trouble hunting on interior wiring due to defective supports was running into thousands of dollars per year.

An insulated staple of proper design and construction is far superior to any single pronged wire support for such purposes for the following reasons. In the first place, an insulated staple driven over all the wires furnishes absolute protection to the insulation on the wires. A single pronged support driven between the wires does not furnish such protection as its bare shank is resting against the wire. Again, in driving anything between twisted pair wires the wireman is apt to drive through the insulation and destroy it. An insulated staple holds the wires firmly and will hold the slack; a single prong fastener will not. Therefore, fewer staples have to be used and they really cost less not only for material but also for labor.

When turning corners an insulated staple holds all the wires together with the strain on all of them, whereas, with a single prong fastener all the strain is thrown on one of the wires. In this case too the staple is still affording perfect protection to the wire, whereas, with a single prong fastener the wire is pulled tight against practically the bare metal shank.

The insulation on an insulated staple can be made of durable fibre which will last forever and cannot be pulled off. On many single prong fasteners the heads fly off under any strain and on others a rubber tubing, which quickly rots out, must be used to protect the shank.

Staples can be used over single ground wires, single prong fasteners cannot be. Therefore, the amount and varieties of stock carried can be reduced by using only insulated staples. When staples are used the wires do not have to be separated with consequent delay and added labor cost.

The above covers interior telephone wiring where it can be ran over wood work and a driven wire support used. Where wiring must be run over plastering or where a screw fastened support is desired a cleat is necessary.

The requirements for a proper form of cleat are that it should be strong, durable, hold the wire effectively, and small and inconspicuous as possible. The cleat should be of such material as not to split or crack either in handling or when screwed up tight enough to hold the slack wire.

It has been proved absolutely that a little extra money expended in buying the proper material for interior telephone wiring will pay for itself many times over in saving the time and expense of hunting small troubles and interruptions to service due to short circuits, grounds and even open circuits.

NEWS OF THE ELECTRICAL CONTRACTORS.

The Evans-Dickson Company of Tacoma has the contract to extend the electric wiring in the Federal building and install additional lights in the mailing room.

NePage McKinney & Co. of Seattle have the contract for the electrical work in the new Multnomah County library building, under construction in the city of Portland.

George H. Waite, formerly in the electrical contracting business in Walla Walla, has transferred his business to La Grande, Ore.

NEW CATALOGUES

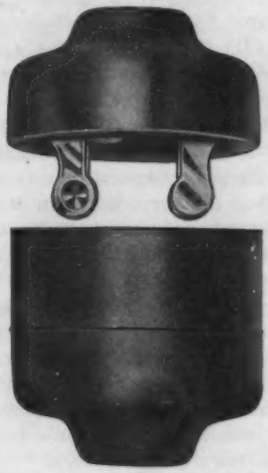
The Crocker-Wheeler Company are distributing Bulletins Nos. 153 and 154. The former deals with direct current lighting and power generators and the latter with oil-insulated self-cooled and water cooled transformers.

The General Electric Company has just issued a bulletin which illustrates and describes its Resistance Units for various motor-starting and speed-controlling rheostats. The number of the bulletin is 4973. Bulletin No. 4975 is a revision of Bulletin No. 4613, devoted to the Synchronism Indicator. Bulletin No. 4977 describes Type MK control apparatus, which is designed for use where single car operation predominates, and where a uniform acceleration is not of such importance as extreme simplicity. This bulletin supersedes, in part, Bulletin 4761. Bulletin No. A4001 describes oil switches which are intended primarily for use in small and isolated alternating current plants of voltages not greater than 3300. The bulletin contains connection and dimension diagrams, and also useful formulas for use in selecting oil switches. Bulletin A4002 describes Polyphase Maximum Watt Demand Indicator, Type W. The instrument is suitable for recording the maximum lead of alternating current circuits irrespective of power-factor and voltage fluctuations.

INDUSTRIAL

NEW COMPOSITION CORD CONNECTORS.

The cord connector finds many uses with the increasing number of portable electric devices. Tailoring and laundry irons, electric drills, etc., can be easily connected and disconnected by means of a cord connector placed on the cord within convenient reach of the operator. With portable vacuum cleaners they provide handy means for disconnecting the long portable cord from the cleaner. A table or desk lamp connected by a cord of considerable length to a base



Cutler-Hammer New Composition Cord Connector.

plug can be easily disconnected by means of a cord connector placed near the lamp. To move the lamp or table it is then only necessary to pull out the cap of the connector and the cord, often run under the rug, need not be disturbed.

A black composition cord connector put on the market by the Cutler-Hammer Manufacturing Company of Milwaukee, is shown in the accompanying illustration. The contacts lock firmly and yet are separated by a pull in any direction. The composition body is made of the insulating material developed in the Ceramic Laboratory of the Cutler-Hammer Manufacturing Company, and which has been used in making other Cutler-Hammer specialties. This material is eminently suited for this device because it is tough and moulds accurately.

THE FLYING OFFICE.

In the annals of naval and land warfare we have heard much of "flying squadrons." It remained, however, for the telephone to make it possible for railway officials to have what may be termed a "flying office." A prominent railroad official recently said, "We railroad men don't have to be tied down to our city offices any more. We can get around over the lines, and see what is going on with our own eyes. Neglect our routine business? Not much! We do just as much if not more, with modern methods."

This is all brought about by the fact that the majority of the private cars in the United States are now equipped with Western Electric telephones, which may be connected at each stopping place to the telephone line by means of a line pole. Over the telephone circuit thus established, the official transacts his routine business as well as takes care of any emergency which may arise. He dictates his memoranda, and even his more lengthy letters, to his secretary or stenographer, who is at headquarters. His private car is his office and without neglecting every-day matters he can make inspections or personally supervise any work, such as clearing up a large wreck, the replacing of a bridge or the clearing of a snow or land slide, while keeping his finger upon the "pulse of the road."

PHYSICIAN'S ELECTRIC CABINET.

Every physician knows the value of many forms of electrical apparatus in therapeutics, but also realizes that the purchase of each one would involve a large investment of money and expensive storage space.

These difficulties are, however, overcome most happily in the compact cabinet illustrated herewith. This device provides, among many other conveniences, a vacuum apparatus, a hot air douche, compressed air without the use of a tank, and vibration upon an entirely new principle. It weighs less than 100 lbs., but places the physician in a position to take care of patients himself whom he would otherwise be compelled to send elsewhere.

Physician's Electric Cabinet.

The vibration, so essential in modern therapeutics, is obtained by causing air to pulsate against a thin disc or diaphragm at the rate of about 5000 times a minute. This action is claimed to resemble nature more nearly than does any other device.

The compressed air and the vacuum obtained are produced by means of a unique fan or blower attached to a 1-10th horsepower motor operating at 1700 revolutions per minute.

Among other electric functions performed by this device are the furnishing of what is known to the medical profession as Galvanic, Foradic and Diagnostic lamp currents when used on 100 volt d.c. circuits and Sinusoidal, instead of Galvanic, current when used on a 110 volt a.c. circuit. The latter can then be furnished through a rectifier.

The cabinet complete with its accessories is made by the Siebert-Welch Company of Columbus, Ohio, and the electric motor for operating the air pump is made by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

NEWS NOTES

ILLUMINATION.

PUYALLUP, WASH.—Bids are soon to be called for lighting the city.

LYMAN, WASH.—The Pacific Northwest Traction Company has made application for a franchise to light the city.

REDWOOD CITY, CAL.—An attempt will be made to extend the city's lighting system through the means of a bond issue, an election for which will be called in the near future.

SALT LAKE CITY, UTAH.—The City Commission passed the ordinance awarding a franchise to the Merchants' Light & Power Company, of Ogden, for the installation in Salt Lake of an electric light and power system.

KIRKLAND, WASH.—From the management of the Kirkland Light & Power Company comes the statement that action would immediately be taken in building a power house here. The machinery for the power plant has been ordered.

VANCOUVER, B. C.—It is announced that application will be made to the government by Bloedel, Stewart & Welch Ltd., for a license to develop a valuable waterpower on the Cheakamus River. The estimated expenditures are $2,000,000.

KAMLOOPS, B. C.—Petitions were read from taxpayers for the submission of three by-laws: $250,000 for a hydro-electric power plant; $90,000 for improvements and extensions to the city water works system; $65,000 for extension and improvement of the city electric lighting system.

MONTPELIER, IDAHO.—The Telluride Power Company is planning for $1,750,000 improvements, including completion of the Bear River reservoir in Utah and Idaho, building of an irrigation reservoir on Bear River at Soda Springs, Idaho, and a generating plant at Oneida Narrows, Idaho.

PALO ALTO, CAL.—The Palo Alto Gas & Electric Company has filed with the Railroad Commission its answer to the complaint of the city of Palo Alto asking the company be compelled to reduce its rate of $1.50. The company agrees to reduce its rate either to a flat rate of $1.40 or a rate of $1.45 to small consumers and a sliding scale down of $1.20 to large consumers.

TRANSPORTATION.

SAN DIEGO, CAL.—The City Council has granted a street railway franchise to the San Diego Electric Railway Company to operate for a period ending in 1952, in this city.

MARTINEZ, CAL.—A deed conveying to the Oakland & Antioch Railway a right of way for several miles through the Rancho Los Medanos, has been filed for record by the C. A. Hooper Company.

KLAMATH FALLS, ORE.—According to George C. Clark, contractor, the electric railway to connect Bonanza with this place is assured. A preliminary survey is almost finished for the entire 26 miles.

BOISE, IDAHO.—The County Commissioners have granted an additional franchise to the Idaho Railway, Light & Power Company to proceed with the construction of the electric road south of Morris Hill cemetery.

LEWISTON, IDAHO.—Z. A. Johnson of Nez Perce announces that he will soon begin the construction of his proposed electric line out of Lewiston through the Camas and Nez Perce prairies at a cost of $1,500,000.

ORENCO, ORE.—The proposed electric line between Helvetia on the United Railway line will probably be constructed this year. J. H. Young, president of the Oregon Electric Railway Company, and others have been here inspecting the route.

OLYMPIA, WASH.—Starting September 1, the Pacific Northwest Traction Company will operate its new interurban line between Bellingham, Mount Vernon, Sedro-Woolley and way points. The company will charge about 3 cents a mile.

LOS ANGELES, CAL.—The Pursell electric line, projected between Los Angeles and San Diego will be completed at once as far as Escondido from the southern terminus if the promoters gain the consent of the State Railroad Commission to place the bonds.

RIVERSIDE, CAL.—W. W. Poole, manager of the Riverside Portland Cement Company, which corporation also controls the Crescent City Railway Company, says that the Rialto extension of the Riverside-Bloomington line will in all probability be in operation by April next.

MERIDIAN, CAL.—The work on the Northern Electric Railroad is progressing as rapidly as possible in this part of Sutter County, and a large force of men is employed. A passenger car is making regular trips from Marysville to Butte Slough, from where a temporary track is being laid to carry material and workmen to Meridian. The rails are now in place to half a mile east of town.

SAN FRANCISCO, CAL.—A double-track railroad to run through the Fort Mason military reservation and to connect with the Polk street line of the United Railroads is to be constructed as soon as permits have been granted by the War Department and the Board of Supervisors. The immediate object is to provide a means of transportation to and from the United States transport docks.

VANCOUVER, WASH.—August 29.—The incorporation of the Washington Electric Railway Company, at Salem, is followed by the announcement that a new electric line is to be built between this city and Tacoma. The place of business of the new company is given as Portland, and the capital stock as $1,000,000. It is understood that the Welsh interests, controlling the Washington-Oregon corporation of this city, are the real backers of the new line.

SEATTLE, WASH.—Reversal of the decisions made by Judge C. H. Hanford in the receivership case of the Seattle, Renton and Southern Railway by U. S. District Judge Ed. F. Cushman when he ordered the Federal receivers appointed by Judge Hanford discharged and decided that the Federal Court had no jurisdiction in the case. Judge Cushman sustained the petition of W. R. Crawford who was ousted from control of the street railway by Peabody, Houghteling & Company of Chicago last fall, that the case should be tried by the State Courts. Both Judge Hanford, who has since resigned, and Judge Rudkin of Spokane, had held that the Federal Court had jurisdiction.

SAN FRANCISCO, CAL.—At the annual meeting of the directors of the Central California Traction Company all of the officers and directors were re-elected, and Bertram E. Abrahamson was chosen a director to fill the vacancy created by the death of Ludwig Schwabacker. An interesting feature of the annual statement for the company was the announcement of a 30 per cent increase in the gross earnings over those of the preceding fiscal year. The officers of the Central California Traction are: Alden Anderson, president; Mortimer Fleishhacker, Herbert Fleishhacker and Geo. W. Peltier, vice-president; H. A. Mitchell, secretary and general manager, and Walter Arnstein, treasurer.

SAN FRANCISCO, CAL.—Plans and specifications for the construction of the overhead trolley system for the extension of the Geary street road from Kearny street to the outer Market street tracks at Sansome street, leading to the ferry, were filed with the Board of Works by City Engineer Marsden

Manson. Manson estimates that the cost of putting the trolley system in working order along the entire line from beach to ferry at $64,000. These plans assume that the trolley wires in Market street will be attached to the United Railroads' poles and overhead system. Specifications for track construction for the westerly extension were filed and referred to the public utilities committee. The cost is estimated at $81,750 for the route beginning at 33d avenue and Geary street, thence to Balboa street, 45th avenue and Cabrillo street to the Great Highway. The bonus is fixed at $150 a day with a 25-day limit. This gives the contractor a chance to earn $3750 extra and makes the total appropriation required $85,500.

OAKLAND, CAL.—For the purpose of constructing a solid pier in place of the present pile structure of the Key Route system the Oakland Terminal Company has issued $1,100,000 of 6 per cent collateral trust notes, maturing August 20, 1913. The bulk of the loan has been taken by a syndicate of San Francisco and Oakland financiers. Torrance, Marshall & Company (successors to J. H. Adams & Company), are offering $100,000 of the issue at par and interest. The notes are guaranteed by indorsement of the Oakland Railways Company and are a first lien on the property known as the Key Route Basin. The Anglo-California Trust Company is made trustee and holder. As additional security the following collateral: $1,843,000 Oakland Traction Company general consolidated 5s, due 1935; $1,413,000 S. F. O. & S. J. Consolidated Railway 5s, due 1938, together with 65 7-10 per cent of the outstanding stock of the San Francisco-Oakland Terminal Railroad Company, representing a controlling interest in what was commonly known as the Oakland Traction Company, the San Francisco, Oakland and San Jose Consolidated Railway (Key Route), the East Shore & Suburban Railway Company and the California Railway Company. One million dollars of this loan is to be deposited with the Union Trust Company, subject to withdrawal on engineers certificate only.

TELEGRAPH AND TELEPHONE.

ARLINGTON, WASH.—The South Fork Telephone Company has been organized and will build a rural line to serve that valley.

BAKER, ORE.—The people of Preston and Dennis are subscribing stock for a company to build a telephone, on which work will probably be started this fall.

LAS VEGAS, N. M.—Improvements that will greatly increase the efficiency of service of the Western Union Telegraph Company are now under way in the local office.

EL PASO, TEX.—The Tri-State Telephone Company has purchased the majority of the physical properties of the now defunct Southern Independent Company. The company is handicapped by lack of sufficient conduit and cable capacity.

OLYMPIA, WASH.—A petition signed by 100 citizens of Castle Rock, urging the consolidation of the two telephone companies operating in that city has been filed with the public service commission. Complaint is made on the ground of poor service.

SAN FRANCISCO, CAL.—O. L. Scott and C. W. Eastin, president and secretary of the Municipal Telephone and Anti-Merger League, have filed a petition with the Board of Supervisors asking that an election be called early in October for the purpose of voting $6,000,000 bonds for a municipal telephone system. Attention is called to the fact that some five months ago the people expressed themselves as favoring the proposition and that it is the duty of the Supervisors to call the election providing for a bond issue.

TRANSMISSION.

KELLOGG, IDAHO.—H. M. Ross, manager of the Nabob Mining Company, announces that a contract has been let with the Washington Power Company to install a power line to the property on Pine Creek. A 75 h.p. motor will be installed and a compressor developing 427 cubic feet of air a minute will be used.

LAPWAI, IDAHO.—The Lewiston-Clarkston Light & Power Company is considering the extension of its lines to the Lapwai valley.

NAPAVINE, WASH.—The Independent Electric Company has asked the County Commissioners at Chehalis for a franchise to operate a power line through this town for the purpose of supplying electricity.

SAN FRANCISCO, CAL.—The Great Western Power Company has filed with the Railroad Commission its answer to the complaint of the Pacific Telephone & Telegraph Company, which charged that the power company, by induction of its lines, had seriously injured the usefulness of the telephone lines. The power company, in reply, declares that if the telephone company's contentions were upheld no power company would be able to maintain a line within 1500 feet of a 'phone line, and that it would be impracticable under such conditions for electric corporations to distribute power in accordance with the requirements of the population.

SAN BERNARDINO, CAL.—The construction work on the building for the second unit of the big steam plant of the Southern Sierras Power Company, in this city, is practically completed, and the machinery is now being installed. The boilers are being put in place, but the plant will be delayed for operation until the arrival of the big turbine, which will not be here for several weeks, it is expected. The early completion of the plant is desired, as it will be called on to furnish juice for the desert sections as far north as Randsburg until the through line from Bishop is ready for operation. Relative to the situation on the desert as to construction work of the high power line, the Randsburg Miner says: The work of stringing the cables is now practically completed to the foot of the mountains north of Randsburg. The early supply of power now depends upon the completion of the substation here, as the current will be furnished from the subsidiary steam plant at San Bernardino until such time as the line can be finished into Bishop. Owing to certain complications about right of way over the aqueduct land in Inyo County, it may be a long time before the power plant near Bishop becomes available.

GILROY, CAL.—The Coast Counties Gas & Electric Company has filed with the Railroad Commission its answer to the complaint recently brought by the Pacific Telephone & Telegraph Company. The telephone company complained that the power company was constructing a high-tension power line in Santa Clara County near Gilroy which would seriously interfere with the telephone service. It requested the Commission to compel the power company to move its line to a distance of 1850 feet from the telephone wires. In its answer the Coast Counties Company states that its line has been in operation in the vicinity of Gilroy since July 1, 1912, and that the telephone company has been able to continue the operation of its wires undisturbed. The power company states, further, that it has operated continuously for about five years a high-tension line charged with 22,000 volts between Santa Cruz and Watsonville in proximity to the telephone wires and that the telephone service has not been injuriously affected. It states also that it is using what is known as "the underground delta system, which gives the least inductive effect known to the art of electrical engineering." The power company states also that the transmission of electricity at a high potential is necessary in the State of California, and that if power companies were required to give way to telephone lines an extensive district throughout the State would remain unserved with electric power.

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